

ANNUAL MAINTENANCE NUMBER

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IN GLOBAL WARFARE

DEC.  
1942  
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# AVIATION

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When you're under fire, you can't limit a ship to the designer's ideal . . . a tactical mission or split-second combat may create conditions beyond the foreseen. An alarm for a sudden take-off—or a critical landing on whatever is below can mean "hell on wheels" . . . and Hayes Wheels and Expander Tube Brakes are facing this in line of duty. And taking it. Performance reports prove it.

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AVIATION, December 1942

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## Dragon's Teeth

There is a legend that tells of dragon's teeth being transformed into an army of vicious, fully equipped for battle.

In this picture you see the legend being reborn. Here are glowing dragon's teeth in the process of becoming a squadron of the most formidable weapons of the skies, Boeing Flying Fortresses.\*

And the legend is being reborn with a vengeance, for since December 7, Boeing workers and production engineers have built the Fortresses with an ever-increasing tempo. Today the rate of production is more than three times greater than it was on the day of Pearl Harbor. (For this performance Boeing

was selected as the first aircraft company in the world to receive the new Army Navy Award for production efficiency.)

The Boeing production system is the only one of its kind in the aircraft industry. Based on the principle of "one division design," the Boeing system makes the most efficient use of men, machines, materials and floor space. So flexible is the production system that important design changes can be made quickly and without interrupting the production schedule. The concentration of all production facilities, so that the plant becomes one tightly integrated unit, makes possible a short, swift flow

of parts through manufacture to assembly.

In building the B-17, for example, the airplane is divided into several major units. As these are manufactured and assembled, they converge into the final assembly line to become a Flying Fortress, complete with instruments and guns, ready to take off to battle.

The increase of speed and efficiency in production . . . both for peace and for war . . . is only one of the many defense projects that form a constant part of the Boeing manufacturing and engineering program at Seattle and in the Middle West and Canada.



## We're Proud

### TO BE BUILDING THE BOEING AT-15

Soon the Boeing AT-15 will be rolling off McDonnell assembly lines in ever-increasing numbers. . . making its important contribution to the success of future bombing missions. For the AT-15 is a new bomber—the first airplane specifically designed for the long-range training of bomber crews.

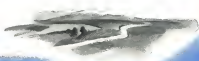
Complete with all essential equipment, this small twin-engine bomber gives flight crews the training in coordination and maneuver necessary before they take over tactical duties in multi-engine bombardment planes.

Equipped with constant speed propellers, radio compass, automatic pilot, full flight

and radio equipment, flexible machine gun, power thrust, and moderate capacity bomb bay, the AT-15 performs all the functions essential to actual combat flying.

Designed and engineered by Boeing to conserve critical materials, the AT-15 is constructed of steel tubing with wood and fabric covered fuselage. Wings and stabilizers are plywood covered.

Yes, we are proud to be part of a team designated to build this plane. For this can teamwork in production contribute to teamwork in the air. Both are essential to victory.



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Left to right: (1) C-47 "Skytrain" (2) C-53 "Skytrooper" (3) C-54 "Skymaster" (4) C-119 "Flying Boxcar"

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# THE BIG GUN



*of the Peace to Come*

America, in war or peace, is progress . . . To more effectively serve the war effort, and prepare for the progress of the future, Formica, now as for years past, is concentrating the energies of a considerable engineering and research staff on the problem of improving laminated plastic material and adapting it to new uses—that there may be better insulated electrical devices, better control for airplanes, better instrument panels, better ignition for all internal combustion motors, more resistant parts for chemical industries . . . If you have problems which might be solved by such a plastic material, this staff will be glad to give you their time and effort in attempting a solution.

## FORMICA

THE FORMICA INSULATION CO. • 4661 SPRING GROVE AVENUE • CINCINNATI, OHIO



AVIATION December 1942

## Bring your Spring Problems to us! *Here's expert help to speed up your war production*

WAR is Hell—and no one knows it better than the design engineer who must rely on fast springs for modern fighting equipment.

Springs for such application must withstand stresses unheard of in peacetime. They must often be ruggedized for use in space and weight. They must function efficiently under incredible extremes of temperature, weather and atmosphere. And they must stand up to service on battlefields in every corner of the globe—in icy, desolate, or stormy jungles, in the frozen wastes of the stratosphere, and the only corner of every one.

These requirements impose problems the designer has seldom faced before. His

job is made more difficult by the fact that shortages of critical alloying elements continuously tend to belittle his choice of the proper steel for the purpose. That is why the help of our spring specialists can be so valuable right now.

These men, as recognized authorities in spring engineering, have collaborated in providing correct springs for every type of apparatus America produces for war. Springs for tank and airplane engines, for anti-aircraft guns, for propellers, bombs, land mines, torpedoes, for precision instruments of all kinds. Their competent assistance is placed freely at your disposal. We welcome this opportunity to meet with you.

**AMERICAN STEEL & WIRE COMPANY**

*Cleveland, Chicago and New York*

Cleveland Steel Company, 501 Franklin, Public Trust Building • United States Steel Export Company, New York



FIRST IN WAR . . .  
FIRST IN PEACE . . .

*U.S. American Quality  
Springs*



# UNITED STATES STEEL

## AN INDUSTRIAL TRAGEDY IN TWO ACTS



"Gee, I have right here before me all the bills for those work-benches we had built in 'C' Bay. They told us something that doesn't even look like your estimate—and it's way over the Hallowell people's price. I told you in the first place I thought we should get Hallowell! Work benches—now I know. Why—these benches would have been on time by days. Now, here is how the matter stands: We put up with the pounding and clutter and bother, wait longer and pay more—and get something that isn't nearly as good. Confound it, man, Hallowell benches would have been an asset—we could re-arrange them or move them around the plant. We made a thundering mistake in not getting the Hallowell—in a damn way outside of price."

See, is it that you don't make the same blunder. If you are contemplating a conversion or addition, get in touch with us before you decide. Don't jump to conclusions as to how much "Hallowell" Equipment will cost or how long you will have to wait until you get our proposition.

# HALLOWELL

## SHOP EQUIPMENT



Fig. 122 "Hallowell" Work Bench with built-in steel work top. Shows in extra, Pat. and Pat. Pending

### STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA., BOX 544

BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO



## Flying start... and a flying finish!

Out of a great North Sea sky battle where four Flying Fortress gave odds of 5 to 1 in a swarm of Focke-Wulf 190s and Messerschmitt 109s, came three new dramatic figures: two men... and a plane.

Faraway far riddled two of the "Johnny Ribs" action. The other two kept it flying. A seriously wounded pilot and a bombardier who "soaked out" of flying school brought it as and out it down, writing a new chapter in the real story of the heroism of American men, and the performance-courage of American machines.

In this highly mechanized war, the ability of an engine to deliver above and beyond line of duty, often decides whether a fighting unit will die for its country... or live for it. Meeting this responsibility requires the best fuel source of effort, of "drive," from every vital part, and especially from piston rings. In many of the nation's fighting planes, as in the Flying Fortress, American Hammered Piston Rings are regularly used.

Probing rings like this take more than a building and

some cushions. It takes the leader and brilliance of research men who continuously seek the ultimate how and why. It takes the skill of foundrymen who create modern casting practices, rather than follow it. It takes the manufacturing genius that designs the speckled cushions not found in any catalog, to produce more rings, better and faster. It takes critical, painstaking inspection by trained inspectors. It takes the engineering "know-how" that has come from 25 years of successfully solving ring problems of all kinds.

Where equipment must have that extra "drive," you'll probably find American Hammered Piston Rings on the job—Koppers Company, American Hammered Piston Ring Division, Baltimore, Maryland.

## American Hammered Piston Rings

a K O P P E R S product

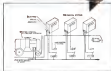
# More Arcs FROM EVERY WELDING MACHINE...

## with the new Wilson "Honey Bee" Arc Control Station



GREATER welding output from every machine, improved arc control, and better welds on thin gauge metal—these are some of the advantages offered by the new Wilson "Honey Bee". Several welding operations can be performed simultaneously from one constant potential arc welding generator—up to the full capacity of the generator. For example, two 150 ampere or four 75 ampere Wilson "Honey Bees" can be connected to any 300 ampere constant potential arc welding generator. Most conventional drooping voltage generators can be converted easily to constant potential. A quick-change switch may be mounted on every Wilson "Honey Bee" arc welding generator for quickly changing its characteristics from drooping to constant potential or vice versa.

Wilson "Honey Bee" stations are connected to



the generator in parallel. The number of stations used (within the capacity of the generator) determines the number of welding operations that can be performed at the same time. Each operator can control his own welding current from minimum to maximum without breaking the arc or affecting the performance of any other station working from the same generator.

## Improved Weld Deposits with Remote Crater Control

To prevent weld defects that result from the abruptly broken arc, the Wilson "Honey Bee" is equipped with a control switch which permits gradual reduction of the current. For example, when welding, the operator can reduce the current from the value at which it was set by pressing a button on the control switch which he holds in his hand. He can hold this button down until the current has been reduced from, (for in-

stance), 65 to 25 amperes. He can maintain it at 25 amperes until the arc is extinguished, or he can control the crater by allowing the current to fall to zero. In either case when he releases the control button, the setting automatically goes back to the original figure. The photograph at right shows clearly how Wilson Crater Control improves the quality of weld deposits.



## Control Mechanism

Controls are fully automatic and are operated by the remote control push button. For convenience this control may be combined with the electrode holder to save time for the operator. The mechanism in the unit is motor-operated, driving a riddle type sliding contact,

which adjusts a resistor having a range of either 0 to 75 ohms or 0 to 150 ohms, depending on the size of "Honey Bee" used. This motor is operated by two directional controllers, bridged by condensers to eliminate sparking or stalling of controller.

## Ratings and Dimensions

Wilson "Honey Bee" Arc Control Stations are made in two sizes: 0 to 75 amperes and 0 to 150 amperes.

Continuous current rating at any setting on an open circuit of 80 volts, constant potential.

	Height	Length	Width	Weight
75 ampere	20"	24 1/4"	11 1/4"	130 lbs.
150 ampere	20"	29 1/4"	13 1/4"	160 lbs.

For further information, call your nearest Air Reduction office

# WILSON WELDER AND METALS CO., INC.

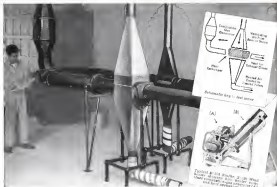
General Offices: 60 East 42nd Street, New York, N. Y.

**WASHED COAT ELECTRODE AVAILABLE ON LOW PRICES**  
Wilson No. 18 Washed Coat electrode is an all-purpose electrode for gasless welding on low carbon and mild steel. It is made in 5 diam — 3/32", 1/8", 5/32", 3/16" and 1/4", with a tensile strength of 45,000 to 60,000 p.s.i. as welded, and elongation is 2% at 7%, to 10%. The surface coating materially improves arc stability and spatter characteristics over those of bare electrodes.





## WE FINISHED OUR FIRST MILLION HEAT EXCHANGERS TWO YEARS AGO!



They also dry more long periods production gas production in less space up to 1000 cubic feet per day to 1000 sq. ft. heat exchanger in less than 1000 sq. ft. of space.

### 7 Years of Practical Experience with Combustion-Gas Heating Now Embodied in Specially Engineered Aircraft Equipment

An essential part of the famous South Wind car is a heater of peace-time war is a highly developed heat exchanger—no bigger than your fist, and perfect for a specific job. And even long before that heater was first marketed in 1935, Stewart-Warner engineers have devoted their skill—and their unmatched engineering facilities—to problems of heat exchange.

Thus when the needs of aviation brought their demand for new and specially engineered heating equipment, Stewart-Warner experts could offer aviation engineers a rich background of specialized experience. To existing facilities already the most complete available, they added a specially built aircraft chamber—combustion-

gas heaters for extending existing engines as they are engines—and other advanced equipment for aviation flight conditions.

The result is a really complete line of aircraft heating equipment—four different types of heat exchangers, plus a wide range of South Wind heating equipment in which the best exchanger are provided with their own combustion-gas heaters. All embody knowledge of aircraft requirements and precise gained in years of cooperation with aircraft engineers—all have performance known in advance—all have benefited by actual field observation by Stewart-Warner engineers on the battlefield.

Charts of all essential performance data on each of our heat-exchanger types are now available.



## South Wind HERMETIC COMBUSTION Heaters

HEATER DIVISION, STEWART-WARNER CORP., CHICAGO

1011 East 10th St. Chicago, Ill. 1935-1936. Aircraft Division, Engineering and Sales Co., 2775 N. Lincoln Blvd., St. Louis, Mo. 1937-1938.

AVIATION, December, 1942



## All's Well! Because He Lands Well On AEROLS\*

★ The pilot of this dive bomber is back from the furthest fighting of a mission successfully completed. Now, as he prepares to land on the carrier's deck, confidence replaces tension. He knows he will make a perfect landing—for his plane is equipped with Aerols!

He is only one of many thousands of pilots who rely on Aerols. For Aerols keep 'em

landing safely and smoothly, not only on mighty aircraft carriers far at sea, but also on flying fields all over the world.

THE CLEVELAND PNEUMATIC TOOL CO.  
AIRCRAFT DIVISION • CLEVELAND, OHIO

Also manufacturers of  
Cleveland pneumatic tools for the aircraft and general industry.  
Cleveland shock absorbers for trucks and buses. Cleveland rock drills for mining and construction use.



# AEROLS\*

FINE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR. THE NAME IS DERIVED FROM THE WORDS "AIR" AND "ROLL" — THE FLUIDS USED TO DISPERSE THE LANDING SHOCKS.



# KNOW THESE FASTENINGS

## They Save Vital Man-hours—assure stronger, tighter assemblies!



**Shakeproof  
LOCK WASHERS**



The lock that vibration cannot loosen!

Each tapered twisted tooth of a Shakeproof Lock Washer bites into both surfaces and acts as a ratchet or strut between the nut or screw and the work surface. As vibration tries to loosen the fastening, it only forces the teeth to bite deeper—thus setting up a powerful locking force which resists any "backing" of the nut or screw. Because of this biting action, these lock washers are highly efficient for electrical and bonding applications.



**SEMS  
FASTENER UNITS**



Pre-assembled for easier handling and faster driving!

Only one unit to handle—no time wasted putting lock washers on screws—no chance to "forget" placing a lock washer under every screw—installations always balance and one order covers both parts. These are just a few of the many advantages SEMS Fastener Units offer. They are certain to speed assembly operations—they reduce costs and assure improved product performance!



**Shakeproof  
THREAD-CUTTING SCREWS**



No tapping—each screw actually cuts its own thread!

In metals and plastics, these Shakeproof Thread-Cutting Screws produce stronger, tighter fastenings and save vital assembly time. Because each screw remains in the perfect mating thread it has cut for itself, a snug, tight fit is always certain. The time-consuming operation of tapping is eliminated and there's no worry about getting or maintaining tap!



**Shakeproof  
COWL FASTENERS**



Easy assembly—quick operation—no stress hazards!

The unique design of the Shakeproof Cowl Fastener gives it many outstanding advantages which appeal to aircraft designers. Its positive locking action—its reinforcing base which eliminates stress hazards and also limits deflection—and its automatic compensation for variation in sheet thickness are indicative of its high performance ability. The design permits installation with a minimum of special tooling!

Send for free Testing Kits and complete technical data book!

Receive one kit of one of the Shakeproof Products shown above by mailable request. Also, if you have not received a copy of the complete Shakeproof Catalog No. 15, we'll send it to you free. Try these Shakeproof Fastenings on your products—write for sample testing kits today.



Bring Your Fastening Problems to "Fastening Headquarters"

**SHAKEPROOF, INC.**

3001 North LaSalle Avenue, Chicago, Illinois

SOLE U.S.A. AND CANADIAN PRODUCT MANUFACTURERS BY ILLINOIS TOOL WORKS  
Branches: London and Tokyo, Illinois • In Canada: Canada Illinois Tools Ltd., Toronto, Ontario  
WHOLESALE AGENTS: • THREAD-CUTTING SCREWS • LOCK WASHERS • COWL FASTENERS • LOCKING  
PIL, PLAIN THREADS • LOCKING SCREWS • NUTS AND FASTENER CLOTH • SPECIAL TOOLS

# PRODUCTION FOR

# AUTOMATIC

## STANDARD Victory MODELS



Model TLN-2 4000 Pount Capacity High Lift Platform Truck for Bulk Transportation and Stacking. Standard Platform is 96" Long 24" Wide 10 1/2" High with 40" to 72" Lift.



Model LNE Standard 6000 Pount Capacity Low Lift Truck equipped with lateral Operator Boom and Motor and Clutch which meet Capacity of 42 Cords.



Model TLN-3 4000 Pount Capacity High Lift Towing Platform Truck for Bulk Transportation and Stacking. Standard Platform is 96" Long 24" Wide 10 1/2" High with 40" to 72" Lift.



Model TLN-4 4000 Pount Capacity High Lift Towing Platform Truck for Bulk Transportation and Stacking. Standard Platform is 96" Long 24" Wide 10 1/2" High with 40" to 72" Lift.



Model TLN-5 4000 Pount Capacity High Lift Towing Platform Truck for Bulk Transportation and Stacking. Standard Platform is 96" Long 24" Wide 10 1/2" High with 40" to 72" Lift.



Model TLN-6 4000 Pount Capacity High Lift Towing Platform Truck for Bulk Transportation and Stacking. Standard Platform is 96" Long 24" Wide 10 1/2" High with 40" to 72" Lift.



Model TLN-7 4000 Pount Capacity High Lift Towing Platform Truck for Bulk Transportation and Stacking. Standard Platform is 96" Long 24" Wide 10 1/2" High with 40" to 72" Lift.

NOTE: In some "AUTOMATIC" approved models may be furnished with special features including: Hydraulic Truck Association, Specialized Equipment for operation in heavy loads that in some circumstances such as in special construction depths and in some cases of special vehicles. These are available in "LNE" and "TLN-2" models. 1000 L.B. and 2000 L.B. models. Platform and special type lift trucks.



Model TLN-8 4000 Pount Capacity High Lift Towing Platform Truck for Bulk Transportation and Stacking. Standard Platform is 96" Long 24" Wide 10 1/2" High with 40" to 72" Lift.



Model TLN-9 4000 Pount Capacity High Lift Towing Platform Truck for Bulk Transportation and Stacking. Standard Platform is 96" Long 24" Wide 10 1/2" High with 40" to 72" Lift.

MANUFACTURERS FOR OVER 35 YEARS  
"Electric Propelled" INDUSTRIAL LIFT TRUCKS

AUTOMATIC TRANSPORTATION CO.  
68 WEST 87TH STREET CHICAGO, ILLINOIS

"AUTOMATIC" is wholeheartedly cooperating with the War Production Board by building only approved types of Industrial Power Trucks to conserve vital materials and to speed up material handling in the War Production effort. Under General Limitation Order L-112 and supplemental order L-112-A issued by WPB, "AUTOMATIC" standard approved models are illustrated and described here.

Let the "AUTOMATIC" representative supply you with full details and show you how the standard approved models can be efficiently applied to your present material handling problems and will be highly efficient for post-war production work. "AUTOMATIC" representatives are listed in the classified telephone directories in the principal cities and industrial areas under "TRUCKS INDUSTRIAL."

## TRANSPORTER LIFT TRUCKS



Model TLN-1 4000 Pount Capacity High Lift Towing Platform Truck for Bulk Transportation and Stacking. Standard Platform is 96" Long 24" Wide 10 1/2" High with 40" to 72" Lift.



Model TLN-2 4000 Pount Capacity High Lift Towing Platform Truck for Bulk Transportation and Stacking. Standard Platform is 96" Long 24" Wide 10 1/2" High with 40" to 72" Lift.



Model TLN-3 4000 Pount Capacity High Lift Towing Platform Truck for Bulk Transportation and Stacking. Standard Platform is 96" Long 24" Wide 10 1/2" High with 40" to 72" Lift.



Model TLN-4 4000 Pount Capacity High Lift Towing Platform Truck for Bulk Transportation and Stacking. Standard Platform is 96" Long 24" Wide 10 1/2" High with 40" to 72" Lift.



## WIRING "HARNESSES"

*Pre-Fabricated to Save You  
Time, Space and Labor*



**S**AVINGS in time, labor and manufacturing space in the assembly of aircraft and their electrical components, can often be effected by the use of pre-fabricated wiring harnesses.

Here in the Wire Division of Electric Auto-Lite are specialized equipment, and personnel skilled in the design and fabrication of wiring harnesses.

And here, under the same roof, we are producing Auto-Lite Sterling "B" Braid Synthetic, approved for all low-tension aircraft circuits from 22 Ga. to 60 Ga. It is light in weight, small in

diameter, tough and resistant to abrasion—gives an exceptionally desirable combination of characteristics as compared with other types of construction.

Result is that here you can obtain your low-tension aircraft wire—have it pre-fabricated into complete "harnesses"—and delivered ready for installation.

Write for complete information on our engineering and production facilities.

THE ELECTRIC AUTO-LITE COMPANY • WIRE DIVISION  
PORT HURON, MICHIGAN

**AUTO-LITE**  
**Sterling**

AVIATION ELECTRICAL  
WIRES AND CABLES

In its 26 great manufacturing divisions  
Auto-Lite is producing for America's  
Armed Forces on land, sea and in the Air



# TRAINING... IS THE ONLY ROAD TO LASTING SUCCESS

## IN CIVILIAN or MILITARY AVIATION



Production and maintenance in the tremendous number of planes developed by President Roosevelt means maintenance by military and civilians for the armed forces of thousands of men who are now training in quantity by what "Spitfire" means. But only the few who hold the "A" rating can begin to work on them. And it is impossible and well paid position either in civil or military aviation. So make sure you are the best available. The only way you can make sure of this is by training. The only way you can make sure of this is by training. The only way you can make sure of this is by training. The only way you can make sure of this is by training.

The students who have made aviation their career have the value of each step in training by two factors: the abundance of money in aviation, and the fact that they are the only ones who can do the work. The only way you can make sure of this is by training. The only way you can make sure of this is by training. The only way you can make sure of this is by training. The only way you can make sure of this is by training.



Getting technical and career help in AVIATION, ENGINEERING & NAUTIC INSTITUTE

*No Money Investment*

**JOIN THE U.S. AIR FORCE**

THIS SCHOOL OVERLOOKS AVIATION'S MOST DISTINGUISHED SCHOOL OF AVIATION





...where they'll do  
the most good

Latest Jefferson-Travis two-way radio communication equipments are limited to the Armies and the Navies of the United Nations. Only the men in combat units or in the most vital services have them. They are where they'll do the most good.

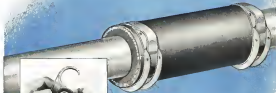
**JEFFERSON-TRAVIS RADIO MFG. CORP.**  
*Manufacturers of Aircraft, Marine and Mobile Radio Communication Equipment*

NEW YORK, N. Y.



WASHINGTON, D. C.

# Service Simplicity



## ADEL STA-LOC HOSE CLAMP



1. Quick and Easy to use. Two place open clamp around the hose.



2. Then swing the locking head to closing position. No tools are needed.



3. Result—tight clamp which exerts even pressure all around.

At last, a service-designed hose clamp which can be re-used any number of times without distress or loss of time! Design Simplicity has done away with nuts, threads and pivots. Fewer parts permit substantial reduction in weight. No special tools or wrenches are required, no special skill! A simple adjustment... and they snap securely into place with a tight grip that is uniform all around. No bulges, heads or concentrated stresses due to forced locking pressure. Made of stainless steel for speedy assembly, long service life, and continued re-use. War industry executives may obtain complete information by contacting the Huntington Division or nearest engineering service office.



We have no threads  
Uniform pressure all around

**HUNTINGTON**  
PRECISION PRODUCTS  
Division of ADEL, PRECISION PRODUCTS CORP.



ENGINEERING SERVICE OFFICES—1444 Washington Ave., Huntington, W. Va., Administration Bldg., Love Field, Dallas, Texas; 609 Sepulchre Bldg., Torrance, Michigan; 321 W. Jackson Bldg., Hagerstown, Maryland; 342 Bay Street, Toronto, Ontario, Canada

## Proper Use...



## Proper Care...



## Proper Selection



## ...saves time—saves materials—saves files



This is a way in which conservation is as important as production. It applies to tools as well as to materials and products. And few tools were more widely than files.

Aviation men will another industrial concern are having to get along with more and more inexperienced workers. It also from experience the use and selection is becoming a growing problem.

Superintendents and foremen can do something about it. Testing or evaluating the value of proper file use and care suggested at the right will help to improve the worker's efficiency, save his time, increase

his output, conserve materials, reduce spoiled work, make files themselves last longer (conserving file stock, too).

Nicholson has literature useful as "shop-floor tests." Write us on any problem or efficiency program in which our experience with files and filing might be helpful. For your file needs, consult your mail supply house.

Free Technical Bulletins at Nicholson or South Diamond Special Purpose File for Machine Work, Aviation, Iron, Lath, Sheet (also for illustration above), Die and Foundry Grating, Files, Die Making, Bone Tool, Filing.

NICHOLSON FILE CO., PHOENIX, A.L.S. U.S.A.  
Litho in U.S.A. Print. Print. Print. Print.

## "DO" and "DON'T"

- Use the right file for the job.
- Don't "start" into the work with too much pressure on the forward stroke.
- Don't "drag" the file back under machine pressure.
- Don't throw files among other work in shops.
- Don't stack files against, or lay them too long on, one another.
- Keep files dry as rain will rust outside their cutting edges.
- Keep files clean of filings. After every few strokes, tap the file on back of wooden block or iron plate. Brush file frequently with dry brush or cork and always before putting the file away.

# Design for Victory



From Southern California come North American B-25 bombers. This is the type of bomber which first blasted Tokio.



From Southern California come North American Mustang fighters...dread scourge of the Axis Nations the whole world over.



From another NAA plant come North American trainers...in which United Nations pilots earn their fighting wings.

Thousands of these bombers, fighters and trainers are the contribution of North American Aviation employees.

ORTH AMERICAN AVIATION, INC., Main Plant, Inglewood, Calif.  
MADRID, BURGESS WAF Production Control, Inc.

# NICHOLSON FILES

FOR EVERY PURPOSE



# ORTH AMERICAN

# Sets the Pace!

New **CASH STANDARD**

# Remote **HYDRAULIC** Control

for ENGINE TEST CELLS

## TRANSMITS OSCILLATING MOTION without MECHANICAL LINKAGE



TYPE 550 RECEIVER

"It has the mechanical advantages that we need," say aircraft manufacturers and aeronautical laboratories now using this Type 550 Remote Hydraulic Control. This CASH STANDARD improved design can be of great value to you, too, in service as engine test cells for controlling throttle position and mixture . . . where it is desired to remotely control the engine from the test boards without mechanical linkage.

Type 550 has positive hydraulic power in BOTH directions . . . no springs, no caps on pistons. It transmits the total force applied to the control lever. Positively brake locks it firmly in any position.

To operate, depress button in

control lever with thumb. This releases the automatic brake. Move the control to any desired position. Release button and control is automatically locked in its new position, where it will remain indefinitely.

### Mechanical Advantages that make possible the better performance

Positive hydraulic power in BOTH directions thus no springs to provide movement and drag.

Transmits the total force you apply to the control lever (no caps on pistons).

No lost motion in either direction.

Positively brake automatically lock Control in any desired position, where it stays locked.

No vent line. The hydraulic circuit is filled by opening the control lever from one extreme to the other.

The inlet connection for the brake is ported to the top of the reservoir in the sending valve. This holds hydraulic pressure in the system equal to the air pressure and prevents air from being drawn into the hydraulic circuit by the vacuum produced by any unbalanced load.

There are two hydraulic lines connecting Sender and Receiver, one also pneumatic line for the air brake.

Sealing with no need for tube crimping



TYPE 550  
SENDER

Receiver can be located above or below Sender.

Lever of Receiver can move 90 degrees.

Receiver lever can be locked in any desired position.

Mounting bracket on Receiver can be adjusted to four positions for convenience in installing.

No mechanical linkage.

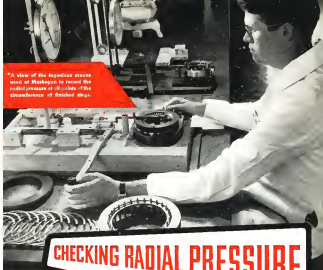
Write for data and list of presentment users.

**A. W. CASH COMPANY**  
DECATUR, ILLINOIS

**CASH STANDARD**  
CONTROLS . .  
VALVES

AVIATION December, 1942

"A view of the ingenious means used at Muskegon to record the radial pressure at all points of the circumference of finished rings."



## CHECKING RADIAL PRESSURE

# MUSKEGON Piston Rings

Radial pressure characteristics—so important to the proper functioning of piston rings in modern engines—are the subject of constant study (\*) at Muskegon. The proper shape, developed by these studies, is designed into the pattern and subsequent casting since the initial cast shape determines the final result.

In aircraft, tanks and jeeps Muskegon rings and Muskegon's "Spartan" and bronze ring castings—by the millions—are performing in war as they did in peace in automobiles, tractors and trucks.

Muskegon engineers are ready at all times to contribute their experience to the solution of your piston ring problems.


**MUSKEGON PISTON RING CO.**  
Muskegon, Michigan  
Pioneers of Muskegon and Sports












**PLEGGED** to all-out aid to America's fighting forces, **NORMA-HOFFMANN** is devoting all its resources and its 31-years' experience, to the production of **PRECISION BEARINGS** for the Army, Navy and Air Corps, and for manufacturers of armament and equipment.



**NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U. S. A.**  
BALL, ROLLER AND THRUST BEARINGS • FOUNDED 1911

AVIATION December 1942



*Bomb B-29 flying fastest Superfortress. Mazda lamps of combat planes are used as more lamps brighter to help keep them operating smoothly—and help them go faster!*

## IT TAKES **200** DIFFERENT **G-E** LAMPS TO BUILD AND FLY AMERICA'S PLANES!

**T**HERE are new lights in darkness Axis does these days. Every time a bomb is released from an American bomber, a signal light from a tiny lamp notifies the bomber that the bomb is on its way.

Chances are it's a G-E lamp, one of the many types of lamps developed by General Electric research in America's leading laboratory of light to meet the special needs of aviation.

G-E makes every type of lamp for every type of flying and ground service. And to hundreds of business modern G-E lighting speeds the manufacture of planes and the

production of materials needed to make them. G-E scientists and engineers who are thoroughly familiar with the problems of aviation lighting are ready to consult with you at any time to help you solve your lighting problems. Problems that may range from the character of glass in some critical place to a production fast to the selection of a lamp specially designed to perform an unusual lighting task. If you have a problem, write General Electric Company, Lamp Department, Nela Park, Cleveland, Ohio.

**SEE** NEXT 3  
PAGES

**G-E MAZDA LAMPS**  
**GENERAL  ELECTRIC**

It takes a lot of G-E MAZDA lamps to

"KEEP 'EM FLYING!"

General Electric research and manufacturing skill have contributed much to the solution of aviation lighting problems—problems involving special voltages, unusual

compactness, special bulbs, special filaments, and exceptional ruggedness. Illustrated on these two pages are some of the G-E MAZDA lamps most widely used in aviation.



**Bomb Indicator.** Used on shore bomb disposal. With amber, green, red or white glass caps. Actual size.



**Instrument Indicator.** Tubular shape. A compact lamp built to fit a small space.



**Instrument Illuminator.** Ideal for an extremely compact source of illumination for airplane instruments. Actual size.



**Instrument Illuminator.** Also fluorescent light. Compactest ever alone was for making signals on dark surfaces. High efficiency, light weight.



**Instrument Illuminator.** Tubular source of blue fluorescent light for projecting star or warning light for illuminating instrument dials.



**Instrument Illuminator.** Provides variable light for certain instrument lighting. Operated by one and three-stage relays.



**Instrument Illuminator.** Larger bulb for instrument illumination. Green light signals and instrument where space permits.



**Alpine Indicator.** Special base inverts positive voltage. Amber plastic cover reflects light into wide angle. Dimmed by turning head of base.



**Bombardier Training.** To outline emergency area for night practice. Fluorescent bulb highly concentrated and wide angle beam. Simple, rugged, proved.



**Gas Light Lamp.** Provides even, well-diffused light upon an light for night illumination. Leads from base.

ON THESE PAGES ARE THE 27 G-E MAZDA LAMPS MOST WIDELY USED IN AVIATION



**Cockpit Spot.** Used with lens to flood whole instrument panel. Bulb has developed especially for Air Force use.



**Cabin Lamp.** But general illumination in plane interiors. Rugged three-stage glow.



**Map Reading.** Light source to be used in reference to map. Light and No. 1000's work table.



**Astrophotograph Lamp.** Projects equal diffuse source of uniform light on standard photographic film. Made with extreme accuracy.



**Signaling.** Having shaped lamp with correct filament.



**Signaling.** Hercules brand. "All-Glass" lamp. Lens, reflector, and filament in one piece. Glass and metal base included.



**Emergency.** Compact, rugged design. High intensity for use in dark light sources with low rate of failure or for general use.



**Emergency.** Life raft marker lamp. Ample to 100-cd or to 1000-cd. Lamp is constructed covered with red glass.



**Landing.** With all the advantages of fluorescent—no glass, no heat, no vibration—these used on some automobiles.



**Landing.** High-intensity, small bulb for use in large reflectors.



**Search.** Projection lamp used for ranging. Operates in grade planes along the runway. 1000 watts.



**Code Beacon.** Flasher system code to plan to give low fog location on the runway.



**Traffic Control.** Suggested program for long and short landing changing mechanism to signal planes for landing.



**Airport Marker.** Used in "runway" to mark in one-fourth mile. Mounted every 100 ft with ground. Also used as boundary or obstruction marker.



**Portable Airport Approach.** Small, light weight, about 100 ft. Can be brought for comparison. High planes land under poor seeing conditions.



**Airport Floodlight.** 10000-watt. Highly efficient lamp to flood airfield.

One of the most important lamps in aviation is the G-E MAZDA Fluorescent lamp, which speeds production in scores of factories that make planes and products for the aircraft industry.

G-E MAZDA LAMPS  
MADE TO STAY BRIGHTER LONGER

GENERAL  ELECTRIC

MAZDA  
40 W

## General Electric can help you break the Lighting Bottlenecks that retard production



Final Assembly of Wing Panels for Curtiss Warhawk requires many parallel production lines close together. Lights cast shadows down between the lines and also into nooks for gasoline tanks and wheels, with no shadows. G-E Mazda Fluorescent lamps were the ideal solution.

**M**ANY war factories today must increase war production without adding extra floor space, machinery, or workmen!

And many factories are discovering that better plant lighting and better lighting maintenance are a practical solution to that problem . . . by breaking production bottlenecks frequently caused by dim or lighting equipment, direct glare, reflected glare, interfering shadows, sharp corners, or insufficient light.

To help break potential production bottlenecks in your plant, General Electric maintains a staff of trained lighting men whose sole responsibility is to help improve lighting in wartime industry.

One of these men will go into any plant or shop, survey the lighting and give live, unbiased recommendations if improvements are needed. Their job is not to sell but to serve. And their first concern is to avoid unnecessary expenditures for new lighting equipment. In many cases, all they recommend is a rearrangement of present fixtures, proper cleaning of bulbs and reflectors, elimination of glare or shadows.

The important thing is that improved lighting also helps production, and it saves expense among workers, who help prevent accidents!

If you run a small war shop or a big war plant, please take advantage of this free service. Telephone General Electric, or write General Electric Company, Nela Park, Cleveland, Ohio.



With G-E Fluorescent Lighting, this girl has no trouble finishing landing gear gear for Curtiss Warhawk. With ordinary lighting, shadows and reflected glare would make it a tough job for anybody!



Theresa Meyer, screw presser, and setting screw detail on wheel clock is hard on the eyes. But she works easily, efficiently, with the new lighting. Like other aviation workers, Theresa now does better work with less fatigue—thanks to better lighting.

Albert Smith, screwing a bumper nut, is a skilled mechanic at Aircraft Division of Wright Body Corporation. "Having some modern General Electric Fluorescent Lighting," he said, "has certainly upped the speed of it in doing precision work!"



## WHITNEY AVIATION DIVISION can help you engineer Aircraft Chains to the job



The Whitney Aviation Division offers a complete service which places all of Whitney's engineering, manufacturing, and technical resources at the direct command of the aviation industry . . . in order to serve more promptly, co-operate more closely, and get required results at shorter time.

This special service is backed by Whitney's extensive experience in engineering roller chains and sprockets into the specialized design requirements of many different aircraft mechanisms and controls. It's a single-minded service that's supercharged for wartime needs. And it's available on a personal, easy-to-remember . . . any time you up.

**THE WHITNEY CHAIN & MFG. CO., HARTFORD, CONN.  
AVIATION DIVISION**

AVIATION, December 1942

47

**G-E MAZDA LAMPS**

**GENERAL ELECTRIC**





## NEW MEXICAN TRAINER Powered by Lycoming

Primary trainers were needed for the rapidly expanding Mexican Air Force. The answer is the growing need in the Lycoming-powered "Tentative", a lightweight plywood trainer. Now in production, it is built almost entirely of Mexican materials and can be repaired in the field by any skilled woodworker. The only imported parts are the Lycoming engines and the instruments.

The "Tentative" has performance qualities that make it ideal for the high altitudes of Mexico. It

can take off with a run of 184 feet and has a service ceiling of 11,500 feet. Its top speed is 110 m.p.h. and its cruising speed is 80 m.p.h.—yet it lands at only 34 m.p.h.

The Lycoming 115 h.p. engine has been chosen as standard equipment on the "Tentative" because of its outstanding performance at high altitudes. Also because, in Mexico as in the United States, Lycoming has for years been considered the synonym for aircraft engine dependability.

YOU CAN RELY ON  
**LYCOMING**  
AIRCRAFT ENGINES



Contributed to 44  
U.S. Army and Navy



THE TRAINING PLANE  
ENGINE OF TODAY  
THE PRIVATE PLANE  
ENGINE OF TOMORROW

WILLIAMSPORT, PA.

LYCOMING DIVISION, THE AVIATION CORPORATION



There is never a minute, day or night, somewhere along the world's battlefronts, when there is not a Beryld-finished plane in the air. The most famous American and Canadian fighters, bombers and trainers, in-

cluding most of the U. S. shipboard bombers, are finished with Beryld materials. Outstanding in uniformity and ease of application, Beryld Aircraft Finishes greatly facilitate maximum combat plane production.

**BERRY BROTHERS**

DETROIT, MICHIGAN • WALKERVILLE, ONTARIO

BOSTON • BIRMINGHAM • CINCINNATI • CHICAGO • ST. LOUIS • EVANSTON, ILL.

**BERRYLOID**  
AIRCRAFT FINISHES



That's the satisfying mark that is being stamped upon rubber products used by Uncle Sam today and that you will use after the war.

HyCar synthetic rubber made in America, by American workmen, and made from materials completely available within the boundaries of the United States, is being produced now in quantity.

The physical properties of HyCar are controlled in manufacture so that in many ways—in performance, long life, and resistance to petroleum—this American-made rubber is better than any rubber ever was.

Total output of HyCar is now going ex-

clusively to war industry for extremely important uses. HyCar chemists and technicians are working constantly, exploring new formulas, and improving products for these applications.

HyCar is supplied as crude synthetic rubber to the manufacturer of finished rubber products. Your rubber supplier can show you HyCar in many types and forms. HyCar maintains research laboratories and field engineers to cooperate with users and suppliers to determine and control the physical properties needed for any specific application. HYCAR CHEMICAL COMPANY, Akron, Ohio.



#### QUARTER-MILERS CAN'T WEAR OVERCOATS

The quick man out for a record doesn't burden himself with excess weight. Nor should the airplane. That's why so many aircraft builders use HyCar for boots, gaskets, fuel tanks and every other place. HyCar gives you superior resistance to oil and aromatic fuels, heat, abrasion, compression set and aging—with a bonus of light weight. For HyCar is 15% to 25% lighter than many other synthetics.

**HYCAR** Synthetic Rubber

LARGEST INDEPENDENT PRODUCER IN AMERICA OF BUTADIENE SYNTHETIC RUBBER

AVIATION December 1942

# Our Eyes are on the Skies.

## of THE PRESENT and THE FUTURE



FOR more than a decade the sky's business space has been the "proving ground" for the aircraft built by Spartan. Dependable, all-metal Spartan "EXECUTIVES" have winged through space and time to a proud record on many missions of the airforce.

Today, Spartan works on innovations to the U. S. Army and the U. S. Navy to help strengthen America's air power. At the same time we continue to keep our "research vision" turned skyward. For just as the war will be won in the air, so will the destiny of the world after the war be decided in the beckoning skies of the future.

More, American eagles fly for freedom... and Spartan is pledged to all-out war production until victory is assured. Then, America will lend the world in the development of a space age era in aviation... and Spartan... with alert eyes on the stars... will keep pace!

\*\*\*



#### SPARTAN SCHOOL OF AERONAUTICS

Graduated as a cadet of the Spartan Aircraft Company, the Spartan School of Aeronautics is now called on the universities that were listed in the universities that were listed in the American Universities officially listed. Spartan School, officially listed, is now called on the universities that were listed in the American Universities officially listed. Spartan School, officially listed, is now called on the universities that were listed in the American Universities officially listed.

**SPARTAN**  
AIRCRAFT COMPANY



TULSA, OKLAHOMA

Contractor to the U. S. Army and U. S. Navy  
BUILDERS OF FINE AIRCRAFT SINCE 1929

# Speaking of Responsibility

Slicks never have been rent by lightning like this. Flying higher and faster than any plane ever built, the newest American fighters will write the history of the world from the skies. "Thunderbolts", they are called—better built than any enemy ship now known... better than the Messerschmitt, the Focke-Wulf 190, or the Jap Zep, excelling even the formidable Spitfire and Hurricane.

When 2,000 horsepower of such flying fury maneuver into fighting position... that's when every control must function without fail. Dumore Aeromotors are providing the power for important equipment in leading warplanes, power for cowl and wing flaps, inter-cooler and oil-cooler exit flaps, anti-icer metering pumps, de-icer distributing valves, ammunition booster units, aerial cameras, flare and bomb releases.

Install Dumore Aeromotors for dependable performance of all equipment, under all flying conditions. Dumore engineers will help you in the application of fractional motor-power to automatic devices, as they have the builders of the best bombers and fighters in the world.

★  
**THE DUMORE COMPANY**  
382-M, RACINE, WISCONSIN  
Builders of Fractional Horsepower Control  
Motors  
★







## Ask for Your Copy of This 56-Page Handbook

### Featuring:

Valuable, timely information on Laminated Plastics construction of vital Aircraft Parts...on Vulcanized Fibre and Phenol Fibre for Electrical Insulation...for Radio...for Electronics...for Silent Gears and other mechanical uses. Write for your copy on your business or official stationery.

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ROBERTSON, PA.

Full Cost Handbooks: 544 South San Pedro Street, Los Angeles, Cal.

# TAYLOR

AMINATED PLASTICS • Vulcanized Fibre • Phenol Fibre •

SHIFTS, RODS, TURBS,  
FABRICATED PARTS

... and with  
**MID-CONTINENT**  
**AIRLINES**  
"air worthiness is maintained."

by using **Snap-on Tools**

To the exemplified endorsement of every major airline, Mid-Continent — *The Great Plains Route* — adds its commendation of Snap-on Tools. "Our mechanics thoroughly understood the importance of maintaining aircraft in a state of seaworthiness," says Robert B. Barnes, Mid-Continent Superintendent of Maintenance, "and they have therefore maintained the required standard of workmanship by using Snap-on Tools."

Free mechanics work with fine tools... and America's vast aviation industry has succeeded and developed the greatest way of free mechanics the world has ever known! Everywhere in the industry...on fast-flowing assembly lines and in great spare parts...in training schools and in maintenance and overhaul shops across the land...



Snap-on's superior speed, flexibility and durability have won widespread preference. Snap-on's 5,000 tools and direct-to-you service are conveniently near you from 55 factory branches at key aviation centers throughout the United States and Canada. Write for catalog and full information.

OVER 5,000  
HAND AND JEWEL  
TOOLS—FROM  
MINOR WRENCHES  
TO HEAVY DUTY  
UNITS



**Snap-on Tools Corporation, 8036 L 28th Avenue, Kenosha, Wisconsin**

AVIATION, December, 1942

Disassembling a crankshaft is one of the many efficient uses of Snap-on tools.



The precision work of cylinder head overhaul finds Snap-on mechanics using Snap-on tools.



# There's a Drafting Board

AWAITING YOUR SHEET STEEL PROBLEM

## at BERGER

• If you have a problem concerning the design or engineering of sheet steel for high-priority production today—or for after-the-war markets—the place for it is on a drafting board at Berger.

Here competent craftsmen are ready to attack it with the experience and knowledge that has been acquired during more than 50 years of fabricating sheet steel.

During that half century, Berger has assisted many manufacturers in the improvement of their products—in helping to make them lighter, stronger, more efficient, more durable, more

attractive and salable, more economical—through the application of sheet steel. During that time, too, Berger has designed and manufactured a comprehensive line of standard sheet steel products on a quantity basis.

So, whatever your problem concerning the design and fabrication of products made of sheet steel, you may save considerable time and money by utilizing the experience and facilities awaiting you at Berger.



**BERGER MANUFACTURING DIVISION**  
STEELTITE STEEL CORPORATION  
CANTON, OHIO

Columbus Division • Toledo Division  
Cleveland Division • Lorain Division • Huron Division  
Detroit Division • Chicago Division  
Birmingham Division • St. Louis Division

Roofing/Under Belts • Cabinet Enclosures • Kitchen Cabinets • Building Products • Office Equipment • Ladders • Shelving



# BERGER

DESIGNERS • ENGINEERS • FABRICATORS  
OF SHEET STEEL PRODUCTS

The items shown above are only a very few of the products which have been manufactured of sheet steel by Berger. There are many others on the complete list.

When considering sheet steel, remember these qualities: strength, light weight, durability, fireproof, variable in design, variety of finishes, low cost.

# BEARINGS THAT FLY

*Must Have "What It Takes"*



This remarkable new testing device is built on a base that permits aircraft engines to be operated in positions of actual flight.

No other application in mechanical history has ever demanded so much from bearings of the size and weight of those supplied by Bunting for modern aircraft engines. New and unprecedented limits are imposed on all operations in the manufacture of these bearings. If unusual requirements today involve a bearing problem, Bunting experience and resources can aid you. The Bunting Brass & Bronze Company, Toledo, Ohio. Warehouses in All Principal Cities.



# Bunting

BRONZE BUSHINGS • BEARINGS • PRECISION BRONZE BARS

AVIATION December 1943

## MEN AND EQUIPMENT

*On the Move,* IN RAIN, SLEET AND SNOW



**N**O TIME OUT in this man's war. Our aircraft must get through in good weather and in bad. The **MARQUETTE ALL-WEATHER WINDSHIELD WIPER** assures clear vision... taking off, in flight and in landing.



*The* **Marquette**  
METAL PRODUCTS CO.

1145 GALEWOOD DRIVE • CLEVELAND, OHIO



## ★ Piston ring engineering

helps win battles! ★

Back of every gun, every tank, every ship, every airplane in this battle come are engineers. The outcome of many battles in modern warfare rests in the hands of engineers.

Sealed Power engineers have sought to equal all past achievements in the production of piston rings, pistons and cylinder sleeves for Army, Navy, Marine Corps, Air Force and Merchant Marine.

Sealed Power men and women are putting forth every effort to produce the finest products in the shortest possible time.

Engine manufacturers, car and truck manufacturers, plane builders, boat builders, repairmen, fleet operators, Army and Navy officers are constantly consulting with Sealed Power Engineers on major engine problems.



## SEALED POWER CORPORATION

Piston Rings, Pistons, Cylinder Sleeves for all types of internal combustion engines, pumps, compressors, etc.

Marquette, Michigan • Windsor, Ontario

BUY  
MORE  
WAR  
BONDS



★ These men standing in the wing of their big Consolidated Liberator were formerly plumbers, druggists, clerks, gangsters, farmers. Now they've finished their training at Camp Cassin.

#### PROBLEM:

It takes a lot of men on the ground to keep a big Army bomber like the Consolidated B-24 Liberator in the air.

Long ago, the Army Air Forces realized that their groundcrew training program must be greatly speeded up. What's more, they urgently needed actual bombers for instruction purposes.

But they knew that such bombers, held back as a groundcrew "classroom," meant one less bomber in action against the Axis. The bombers simply couldn't be spared!

#### SOLUTION:

Consolidated brought the boys to the bombers!

Almost overnight—before the first 500 boys arrived—the company built Camp Cassin, complete

with barracks, mess halls, and classrooms. And still more men in correct hats of the Army Air Forces to take their place as skilled mechanics in bomber ground crews.

with barracks, mess halls, and classrooms.

Here, on a three-week basis for a 35-day school period, the boys of the AAF Technical Training Command are now taught to maintain the very bombers they will later operate.

The bombers themselves, as well as the tools, equipment, and manuals, are provided by Consolidated. The instructors are the men who built the bombers.

The boys are taught to tear down and reassemble the engines. They learn the intricacies of the power turret assemblies, the landing gear, the hydraulic system, and the electrical installation. In short, when they leave, they know their place forward, backward, and blindfolded!

Consolidated, who believes that its responsibility does not end when a bomber rolls off its assembly line, is proud that it can make this important contribution to the training of Army Air Forces personnel.



## Roots for Victory...

Like the Harvest, America's production is the fruit of many labors. To those who have helped so greatly in the past year—the planners, the builders, the workers... the men in many fields of activity whose efforts have speeded our program—Wright extends its appreciation for accomplishment.

**WRIGHT** Aircraft Engines

POWER THE TERRACE OF THE AIR

## CONSOLIDATED builds Battleships of the Air

LIBERATOR . . . CORONADO . . . CATALINA

AVIATION Division, 1943



Field Servicing a B-24D

## "THE LIEUTENANT WILL BE GLAD TO KNOW"...

Any pilot is glad to know that the ship he flies is protected with boots all over it, self locking ones. That knowledge gives him an added sense of security, because Boots Nuts are safer, even the strongest vibration cannot jar them loose. They are unaffected by the corrosive action of oil, chemicals, or weather. Their resistance to high temperatures is almost phenomenal. In fact, they literally "outlast the plane."

Not only that, but, because they are more easily applied, they cut down the time a plane must spend on the ground for maintenance and repairs. And, of course, that means more fighting time, which is the most important consideration of all.

On every battle front in the world, on every type and "most every make of plane, these ingenious fastening devices are contributing to the striking power of our Air Force.

# BOOTS

Self Locking Nuts for Application in All Aircraft



### It's Self-Locking

The basic principle of self-locking as employed in the Boots, Frigs, and Hot Top Industries closed shank one self locking throughout the aircraft in duty in whatever the nut is one piece, self-closed. The self-locking nut is achieved by means of the nut of plane locking after inserted in the hole thereby by means of a solid spring member.

Here are a few of the planes featured with Boots Nuts:

Superior Whirlwind B-24  
Boeing Flying Fortress B-29  
North American B-25  
Curtis Commando B-24  
Consolidated Liberator B-24E  
Curtis P-40  
Curtis One-Bomber B-24  
Boeing B-29  
Boeing B-29  
Boeing B-29

**QUALIFICATIONS FOR GLIDER PILOT TRAINING** 1. Men between the ages of 18 to 35 inclusive, holding a currently effective C. A. A. License's Certificate, private grade, or higher. 2. Or, holding a C. A. A. License's Certificate, private grade or higher, that has lapsed since January 1, 1934. 3. Or, a certified statement showing completion of 700 or more glider flights. 4. Or, if with no a former aviation under or aviation student, who has completed at least 20 hours of total flying time, either dual or solo, of any Army, Navy or other service flying school. . . . . . Get in touch with your nearest recruiting office.



## IMPACT STRENGTH!

Out of the silent skies will come shock-titanians of the Winged Commandos. These multi-phasing, change poses will lead their impact strength when and where the enemy is least prepared.

Impact strength rides with them in these gliders. Aero-Quartz Lumarith is used in cockpit enclosures, which shields and parts, Lumarith Molding Materials are used for many other vital glider and "plane parts." The im-



port strength of these super-tough plastics—even at the low temperatures of high altitudes—is greater, in some cases, than the strength of

other plastics at room temperatures.

One of the lightest and most transparent plastics known, Lumarith is shockproofed. Its specific production process is so easy to learn—roughly, Lumarith needs no curing. It is impervious to water and has excellent weathering qualities.

## CELANESE CELLULOSE CORPORATION

The World's Leader in Plastics

4 chance Cellulose Corporation, 125 Madison Ave., New York City, a division of Celanese Corporation of America, Inc. Producer of Celluloid® (cellulose nitrate plastics, film base and paper). . . . Lumarith® (cellulose acetate plastics, film base, and many other uses, including and transparent packaging material and paper). . . . Lucite® (E. C. Polyethylene molding material). . . . Treadwell® (Ray A. N. Pl. Co.). Representatives: Dayton, Chicago, St. Louis, Detroit, San Francisco, Los Angeles, Washington, D. C., Cincinnati, Montreal, Toronto.

THE R.A.F.'s

*Hit and Run*

SPECIALIST!



Douglas  
E.A.7 "Boston"

Photo courtesy Douglas Aircraft Co.

THIS shifty brawler can dart in and unload its bombs right on top of a target. It's fast enough to outsmart ack-ack gunners and dodge enemy interceptors. Such performance calls for a high degree of maneuverability—controls must respond to instant demands without friction, without drag, without fail!

Fafnirs guarding control efficiency supply the needed, extra margin of safety at the vital

points of motion on many American-built battle planes figuring in the headlines these days. Fafnirs have always played a brilliant part in the development of our great aircraft industry. From "burn-turner" to aileron to fighting plane—Fafnirs on the controls have meant positive responsiveness and freedom from friction. The Fafnir Bearing Company, Aircraft Division, New Britain, Connecticut.

Send for our new Fafnir Aircraft Service Manual, you will find it an invaluable service on the

**FAFNIR**  
Ball Bearings  
for Aircraft  
Engines and Controls

## STA-KONS

T & B Small Wire Terminals  
for the Aircraft Industry are  
available with

### INSULATION GRIP



THE INSULATION GRIP hugs the insulation and supports the wire. It takes the brunt of the stress and strain due to sharp bends, vibration, etc. It cuts down stress on the strands of the copper conductor at the terminal to a minimum. Gripping Ends are wrapped around the insulation and interlock firmly. Because of their design, they cannot injure the insulation.

Both Hand Tools and Bench Tools are offered for staking these T & B Pressure (solderless) terminals and wrapping the Insulation Grip.



For complete engineering data see your new T & B Aircraft Catalog No. 36, or write us your particular requirements.



**THE THOMAS & BETTS CO.**  
INCORPORATED  
MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899  
ELIZABETH, NEW JERSEY

AVIATION, December, 1942



## POWER TO WIN

Continental Red Seal Engines — dependable sources of power for more than 45 years — are now being produced in ever increasing volume. Continental "Power to Win" is the coordinated result of advanced engineering, research, and manufacturing skill.

Your dollars have power, too

**Continental Motors Corporation**

Aircraft Engine Division  
MUSKOGEE, MICHIGAN

# There's Stamina and Performance with **McQUAY-NORRIS** ALTINIZED **PISTON RINGS**

**PISTONS .. PINS ..  
HARDENED & GROUND PARTS**

McQuay-Norris, a pioneer manufacturer of parts in the automotive field, is devoting itself in increasing measure to the aviation industry. Our Aircraft Division projects the McQuay-Norris policy of clinical research into this important field with the result that we are continually adding to available parts, technical assistance and research experience. Your inquiries are invited.

**WORKERS IN IRON, STEEL, ALUMINUM, BRONZE, MAGNESIUM**



**McQUAY-NORRIS MFG. CO. (AIRCRAFT DIVISION), ST. LOUIS, U. S. A.**



Illustration: Final inspection of a Solar Exhaust Manifold.

"—for accomplishing more than seemed reasonable or possible a year ago"—the men and women of Solar Aircraft have received the Army-Navy Production Award. Proudly with this pennant fly—on inspiration to greater achievements.

**SOLAR**  
EXHAUST SYSTEMS—

SOLAR AIRCRAFT COMPANY • SAN DIEGO, CALIFORNIA

and now ---

THERE IS NO GEAR TOO SMALL  
TO BE FINISHED BY "SHAVING"



A one inch diameter angular gear being finished on a new Michigan 861-4B.



The new Michigan 861-4B which will accurately finish machine the smallest gear in far less time than it takes to read this advertisement.

For the past few months we have been busy telling you about the new "Michigans" on which you can shave gears up to 4 ft. in diameter.

Now we would like to introduce to you the new Michigan 861, designed for the producer of small gears—for instruments, for control mechanisms, etc.—from a maximum of four inch diameter down to as close to zero diameter as you can make a gear.

It will handle gears up to 1 inch face width and down to "nothing". The gears can be mounted on shafts up to 9 inches long or they can be annular types with no shafts at all.

Just rough them out, put them on the Michigan 861-4B crossed axis gear finisher and in a few seconds they will be finished to within tenths of a thousandth.

**MICHIGAN TOOL**

7171 E. MICHIGAN ROAD *Company* DETROIT, U.S.A.



# Just by KEEPING WELL You can help win this war!



*"It would help  
save the doctor's  
time if you'd  
come to his office,  
Mr. Jones."*

## FOLLOW THESE 5 RULES

Remember these five keys to good health. Follow them carefully—for your own welfare and for victory.



**1. Eat Right**  
Milk, butter, eggs, fish, meat, chicken, bread and fruit, fresh, green leafy vegetables and the purple ones, whole-grain or cracked cereals and bread—these are the key foods. Eat plenty of them. And eat 3 meals a day!

**2. Get Your Rest**  
Regularly counts much. You can't catch up on the sleep you miss!

**3. See Your Doctor Once a Year**  
You have your car checked and serviced every thousand miles. Do as much for your body. Physicians can prevent many diseases and diseases for both children and grown-ups now.

**4. Keep Clean**  
Plenty of baths, lots of soap. Clean hands, clothes, house, bed! Get fresh air, sunlight. Drink lots of water.

**5. "Play"**  
Keep up the family, mix with friends, take walks, play games—or do whatever you like to give your mind and body a change from the daily grind on the job. All work and no play makes Jack a dull boy.

(Courtesy, Institute of Life Insurance)



## A Platform Where You Want It—As You Want It

What's the job—along the wing? Rudder and tail sections? Engine nacelles? You can quickly and conveniently service them all with this.

## UNIVERSAL Repair Stand\*

Note from the photographs how each master unit can be "opened up" to form a platform 6'6" long at any height from 3'6" to 6'6". A top of the hinged cover in center of stand provides an adequate support for work. . . . arrangement of two or more Universal Stands permits an "E", "L", "T" or "Z" shape or a hollow rectangular platform—combination that covers every phase of "high coach" aircraft maintenance.

While in use these light, versatile stands are held rigid and motionless by means of Housch Truck Locks. The job area, a slight push sends them rolling to the next operation on sparkplug plastic wheel-end centers.

Used presently, 4,800 Universal Stands were "special jobs," but their success in both civil and military service has prompted us to establish quantity production. . . . Glad to send you further details and quote prices and delivery dates. Write or wire today.

\* PATENT APPLIED FOR



Width of the top of a single unit (stand) is adjustable from 6'6" to 6'6". Height of the top of a single unit (stand) is adjustable from 3'6" to 6'6".

**THE WOLFE & MANN MFG. CO.**  
AIRCRAFT EQUIPMENT DIVISION  
28th. & SISSON STS., BALTIMORE MD.

THIS SPACE CONTRIBUTED BY THE BQ CORPORATION

★  
Who are these Men and Women?

They are the Experimental Department personnel who built the world's first jet flying boat—the Navy's new Martin Mars . . . What have they won? They have put in the air a flying plane that points the way toward winning the war and showing the peace . . . Inevitably, great cargoes of men, machines and supplies must be carried by air before the battle is won. Inevitably, fleets of heavy ships will steam from each portland in this ship which will transform the face of war . . . And beyond that lies the peace—where air commerce will move people and their products, will cement new friendships and help heavy old hatreds, suppress

and passions. Would peace will be built on world understandings made possible by air commerce . . . What have these men and women done at Martin's? They have done more than build a great airplane. They have helped America take a new step toward Victory and World Peace. The Quana L. Martin Company, Baltimore, Maryland, U. S. A.

**Martin**  
AIRCRAFT



## Behind the Man and the Machine are Master Designers



Leading aircraft manufacturers keep coming back for **HECKER** engineered tools. Good reason why.

First, our engineers know production problems by rubbing elbows with them right here in our own plant. They set many of their tools, jigs and fixtures on the job.

Second, **HECKER** is geared up to pinch-hit our customers' tight spots.

Third, consistently satisfactory experience with the tools we have designed and produced.

Whether your immediate problem is tool engineering or actual production of precision parts, **HECKER** service can

help you. Our organization is old in experience, young in progressive ideas.

Give us a crack at one of your tough problems, just as a input of this service. That's your chance to learn how we work, our chance to make a friend and continuing contact.

Write A. W. Hecker, 1979 East 66th Street, Cleveland, Ohio.

A-W-

**HECKER**

DESIGNS AND PATENTS BY PHIL. HED  
AND OTHERS • MANUFACTURED BY AIRCRAFT PARTS





PHOTO COURTESY OF A. J. MALLORY CO.

## Mallory Parts Help "Keep 'Em Flying".... 300 Miles an Hour Sitting Still!

When he pulls down the hood of this Link Instrument & Radio Pilot Trainer, the student flies at the controls just as if he were in actual flight over fog-bound or blacked-out terrain. He has to rely on a panel of flight instruments and on his radio equipment to guide him to his "objective".... at 300 miles an hour sitting still!

To keep Uncle Sam's newest learning in Link Trainers, several Mallory precision products are used. Potentiometers to control the volume of simulated radio signals—those often selected by Mallory selector switches. Rheostats for cockpit lighting; pilot light assemblies and push button switches to control signal lights. Phone plugs and jacks for both instructor's and student's microphones and head phones. Clamped contacts to insure the automatic landing device that produces various "keyed" signals, to keep the pilot on course.

All these Mallory products are vital to the performance of communications devices and navigation instruments.... not only in the Link Trainers, but also in many actual airplanes now flying!

R. E. MALLORY & CO., INC., INDIANAPOLIS, INDIANA • Cable Address—TELEMAIL

Subsiders Reg. U. S. Pat. Off.—Patented Inventions—Phonograph

# MALLORY

SERVES THE AVIATION, THE AVIATION-INSTRUMENT AND THE AVIATION-COMMUNICATION FIELD WITH WELDING TIPS, ELECTRICAL CONTACTS, SPECIAL ALLOYS, MALLOWS, VIBRATORS, VIBROPHONES, CONDENSERS, ROTARY SWITCHES, SINGLE AND MULTIPLE PUSH BUTTON SWITCHES, COMMUNICATIONS HARDWARE, RECTOSTARTERS

over sky battles from the Arctic Circle to the South Pacific.

Yet electronic products are only a fraction of Mallory's share in the aircraft industry. Mallory Standardized Resistance Welding Electrodes speed the assembly of fuselage and aircraft parts... fabricated from stainless steel, aluminum alloy and other materials... by spot, seam and flash or butt welding. Mallory Electrical Connectors supply the "vital joints" for airplane devices, from headsets to variable pitch propellers. No lead burnings, burnings and misconnections are so easily silver-soldered to carry today's heavier horsepower loads. Mallory Rheostats speed testing of aircraft electrical equipment, starting of "ground" engines and charging of airplane batteries.

If you're air-minded, you should be Mallory-minded, too. For Mallory makes electronic and mechanical equipment are solving plenty of problems before they leave the drawing-boards of aircraft manufacturers. You'll find us ready, willing and able to cooperate. Write us about your problem today!



## with GAS TANKS sealed in a FIRE-KILLING ENVELOPE

HELL breaks here when a tracer bullet tears gasoline tanks

Deaf, when a tracer whizzes through the gasoline tank of an American battle plane, it is as if it landed hard in a muddy field. For this there are two good reasons. One inside the tank, and one outside. We guard both of these vulnerable spots.

The empty gasoline tank is the dangerous one. Force-Blind, it needs only a spark to explode it. So Walter Kidde & Company provides a "popping system." The pilot pushes a release, inside Kidde carbon dioxide gas into the tank. Explosive pressure turns on vented snap-guns replaced

by inert carbon dioxide gas, slowly seeping to flame and fire. That's one much desired of a fuel tank system. But suppose a well-aimed tank gets guaranteed, holes a hole, and flames off the area between the tank and the outer skin. What's a tracer explode the system, collapse the tank or destroy the wing? It can. But it doesn't get the chance. There's another Kidde cylinder that pours carbon dioxide gas into the space, ready to stuff out the

flame if it hits.

Kidde makes it live in the air and on the ground... expert in handling of high pressure gases... in making new research experiments. If you have one, let us know.

# Kidde



Walter Kidde & Company, Inc., 1222 West Street, Bloomfield, N. J.

# HOW TO GET THE MOST OUT OF YOUR LATHES

No. 3 in a series of suggestions made by the South Bend Lathe Works in the interest of more efficient war production

## Keep Your Lathes Level

The leveling of a lathe can either perpetuate or destroy the best craftsmanship of the machine tool builder. A lathe that is not kept perfectly level cannot turn out the precision work for which it was built.

The lathe bed is comparable to a mason's surface plate. Upon a cast the headstock, carriage and tailstock. Therefore, any twisting of the lathe bed will throw the headstock, tailstock, and carriage out of alignment. This will cause the lathe to turn or bore a taper instead of taking a straight cut. It will also cause the alignment of the tailstock, center point to shift as the tailstock is moved along the lathe bed, necessitating constant readjustment of the tailstock top set-over.



Every lathe should be checked periodically to see that it is level

### Check Leveling Frequently

The major cause of distortion in lathe beds is the settling of the floor supporting the lathe. This is most commonly encountered in buildings that do not have solid foundations or that have wooden floors or columns. There are numerous other conditions which can cause this, such as the shifting of loads on the floor, swelling of wood flooring, deterioration of wooden shores and atmospheric changes. For these reasons, every lathe should be checked periodically to see that it is level.

### How to Level a Lathe

The first requisite for accurate leveling is a precision level at least 12" long. One that is sufficiently sensitive to show a distinct movement of the bubble when a .005" shim is placed under one end of it. A carpenter's level, a combination square level, or an ordinary machinist's level cannot be used because they are not sufficiently sensitive.

The leveling of the lathe is tested

by placing the level squarely across the lathe bed, immediately in front of the headstock, and also at the extreme right end of the bed. On lathes having long beds, tests should also be made at one or more intermediate positions. Be sure that the wires are wiped perfectly clean of all chips or dirt before using the level.

Metal shims should be used under the lathe at the points indicated by the level to bring it level. Some lathes are equipped with leveling screws making it unnecessary to use shims.

After all adjustments have been made, both the lathe visually to the floor and against the tests to make sure that tightening the bed bolts has not altered the leveling of the lathe.

### Alignment Test

A simple alignment test can be used to check the leveling of a lathe. Place a bar of steel, one inch or

larger in diameter, in the chuck and machine two collars of equal diameter three or four inches apart. Then, take a very light finishing cut across both collars without changing the setting of the cutter bit. Measure both collars with a micrometer. If the collars are not the same diameter, it is an indication that the lathe is not level. Adjust the leveling until, when a cut is taken, both collars are turned the same diameter.

### Write for Bulletin H3

Bulletin H3 gives more detailed information on the installation and leveling of lathes will be supplied on request. Also reprints of this and other\* advertisements and bulletins in this series. Write quantity.

\*Ad. No. 1, "Keep Your Lathe Clean" Bulletin H1, "Keep Your Lathe Clean" Ad. No. 2, "Dressing the Lathe" Bulletin H2, "Dressing the Lathe"

The *Electroforged* Process

PUTS LONG LIFE and ACCURACY in **AIRCRAFT RIVET SETS**



Copies of this complete catalog, which fully describes the wide range of Aircraft Tools, Inc. products, are available to industry personnel when requested on company letterheads.

The exclusive Electroforged process assures better rivet structures, uniform heating and accuracy that is responsible for the long life characteristic of Aircraft Rivet Sets. This process is typical of the many advanced production methods used in making the Rivet Sets, as well as all Aircraft production and maintenance tools.

**Aircraft TOOLS, INC.**   
LOS ANGELES • CALIFORNIA

2000 S. W. 10th Ave. • Los Angeles 15, Calif. • Phone: 475-1234 • Telex: 910000 • Cable: 910000 • Registered U.S. Patent Office • Copyright © 1947 Aircraft Tools, Inc. • All rights reserved.



**SOUTH BEND LATHE WORKS**

South Bend, Ind., U. S. A.

Lathe Builders for 36 Years

AVIATION December 1947

AVIATION December 1947

# Safety

depends on little things



No need to fret or concentrate as the bigger things of war because he knows the "little" things that sometimes mean so much have been taken care of. Little things like pin-chisel fittings, for example. Most men in design (and manufacturing) are using Airborne-Joyce Pinchchute Hardware for greater safety and reliability.



Companies served by Joyce: Aero-Rite Supply, General Co., Atlantic Supply Corp., B. W. Roberts Co., J. J. Campbell Co., Cheney Brothers, Cole of California, Inc., Crawford Manufacturing Co., Inc., Eagle Pinchchute Corp., Finkenbros, Inc., Hayes Manufacturing Corp., Highland Box Co., Irving Air Brake Co., Inc., J. D. Marshall Corp., The Mills Co., National Automotive Fitness, Inc., Parsons Pinchchute Co., Inc., Reliance Manufacturing Co., Standard Pinchchute Corp., United Steelbush, Wm. E. Wright & Sons Co.

**JOYCE Aviation, Inc.**

PARACHUTE HARDWARE • COLLAPSIBLE WHEEL CHAIRS • EJECT AIRFIELD COMPUTER • WOODING ANCHOR FIT • TOW-TABNETS FOR AERIAL AND AIR-PLANE SURVEY • CHAIRS SAFETY BELTS • AIRCRAFT SPINNER AND PROPELLER BLADES

## Do you machine aluminum?

**Gulf Cut-Aid will help you get higher production speeds, better finishes and longer tool life!**

**I**N plant after plant, Gulf Cut-Aid is demonstrating its superiority as a cutting fluid for aluminum. Here are typical results with this revolutionary new Gulf product:

1. Operation—turning aluminum castings, 3/4" cut. Result using Gulf Cut-Aid—20% increase in production, 75% better finish (on 1), longer tool life.
2. Operation—tapping a 3/4" diameter hole in a 1/2" thick aluminum cover plate.

**Problem**—1 part in 30 rejected due to cracking. **Result**, using Gulf Cut-Aid—over 500 cover plates tapped without a reject.

In addition to its function as the ideal cutting fluid for aluminum, Gulf Cut-Aid has another important function — it is an effective emulsifier for other cutting oils, regardless of type or viscosity. Blended in varying proportions depending upon the various requirements of the job, the use of Gulf Cut-Aid with other cutting oils results in improved finish or longer tool life, or both.

Gulf is a Gulf service engineer today and let him demonstrate — in your plant — how Gulf Cut-Aid and other Gulf quality cutting oils can help improve your machining practice. Gulf Oil Corporation, Gulf Refining Company, Gulf Building, Pittsburgh, Pennsylvania.



Undercutting the valve seat on an aluminum alloy cylinder head in the plant of a piston and crank engine manufacturer.



Gulf Oil Corporation Gulf Refining Company  
3000 Gulf Building, Pittsburgh, Pa.  
Represented in your area by a copy of the pure handling,  
Gulf Cutting Oils — which includes a 10 page Machinery Guide.

Company \_\_\_\_\_  
Name \_\_\_\_\_  
Title \_\_\_\_\_  
Address \_\_\_\_\_

## NEW OPERATORS..

*but the Same job  
being done Faster  
with the Same*

## *Thor* PORTABLE ELECTRIC DRILLS



NEW OPERATORS . . . men and women . . . filling in on today's troubled wartime shifts are doing the same fast production jobs as the veterans with Thor Portable Electric Drills.

Not one ounce of the needed power and stamina packed into the Thor portable drill is lost when it is turned over to a new operator . . . because the compact, lightweight Thor design makes the drill easy to handle.

Every one of Thor's U-14 series portable electric drills has power of tools twice their size! Ranging in weights from 2½ pounds to 4½ pounds, and in lengths from 7½ inches to 10½ inches, they are available in all sizes, speeds and switch styles to do every type of fast drilling job.

Send today for full particulars on these and other drills in the complete line of Thor Portable Electric Tools in the new No. 33-A Catalog



THOR U-14  
PORTABLE ELECTRIC DRILL  
Smallest of the Thor U-14 Series Portable Electric Drills is the U-14A . . . weight 2½ pounds, length 7½ inches, drilling capacity 3/8 inch.

*Thor* Portable Pneumatic and Electric Tools  
INDEPENDENT PNEUMATIC TOOL COMPANY



800 W. JACKSON STREET, CHICAGO, ILL.  
Branches in Principal Cities

AVIATION, December, 1942



## *Knights in Armor*

Over Europe, in Asia, in Africa, in the South Pacific and in the Aleutians, American Flying Fortresses are smashing the enemy in every area. This long-range, high-altitude bomber is wearing something new—something that has given it remarkable defensive ability—even when fighter escort is lacking.

This great offensive airplane now wears a coat of mail at the true moment of the knight of old. Deadly defensive blows from the "belly bubble" and its companion upper turret protect this modern knight in reaching his objective, mining havoc on the enemy, and returning to base. Every angle of attack is covered by machine-gun fire from these precision power-controlled Sperry turrets and the Boeing "stinger" in the tail.

A product of Sperry Laboratories, the development, design, scientific investigation and engineering of both the upper turret and the lower ball turret were accomplished a full year before Pearl Harbor. At the onset of hostilities other manufacturers, under license, were soon able to take over the production, and quantities of this vital equipment are now flowing from their assembly lines.



*Sperry Gyroscope Company, Inc.*

ROCKFORD • NEW YORK

# Waste Warden Tells HOW TO GET LONGER SERVICE

## TORCHES

1. Blow out hose before attaching torch.
2. Be sure the torch seat is clean.
3. Be sure packing seal is tight.
4. Also—don't use torch as a hammer. A torch built to withstand such abuse would be too heavy to handle.

## TIPS

1. Clean tip with proper dry-cleaning cloth. Only the fire is in a draft one size smaller than the orifice about to be cleaned. Makefile wire cleaners enlarge tip openings and upset flame balance.
2. Store all tips in racks to prevent damage. Tips battered at landing and waste gas.

## REGULATORS

1. Keep regulator seat dust free. Before attaching regulator, clean seat by cracking cylinder, clean bleed by a short blow from cylinder.
2. Release regulator adjusting screw when changing cylinders. This prevents high pressure shocks to regulator seat.
3. Always open cylinder valve slowly when installing regulator. Repeated sudden cracking of cylinder into regulator promotes leakage.

from your  
Welding and Cutting  
Apparatus



## DON'T JUNK DAMAGED APPARATUS

Today regulators, tanks and tips are hard to replace. Good maintenance practices will help you get longer service and better performance from your gas welding and cutting apparatus.

But if a tank, tip, or regulator is damaged—don't junk it. Instead send it to an Airco Apparatus Repair shop where factory-trained repairmen will make it work like new. This nationwide repair service is available through your nearest Airco office.

## AIR REDUCTION

60 EAST 42ND STREET, NEW YORK, N. Y.

IN TEXAS: MAGNOLIA-AIRCO GAS PRODUCTS COMPANY



OXYGEN IS PRODUCTION — Don't Waste it!

We'll live!...to fight again



IN THE oil-darkened waters of a darkened sea, one of our lighting searchlights forced down Miles from sea level—wading was less than a dot on a limitless expanse of ocean—the pilot's life could well be shattered if, were it not for the swift rescue boats whose ever-watchful patrol never ceasingly fighting men in light again.

These crash boats are ready for any emergency, and their ability to get there on a hurry-up basis is tribute to their sleek design and to the highly efficient engines which power them. Behind the whirling propellers which speed these craft through the water are gears—Foote-Bros. gears of such extreme precision that until a short time ago, they were considered a laboratory product.

But engines for rescue boats and torpedo boats—engines for fighters, bombers and naval destroyers, called for gears in such quantities that only mass production methods could supply the demand.

And today these "jewels of power transmission" are working out in ever-increasing quantities to speed America's fighting forces—to the air and to the water—to Victory.

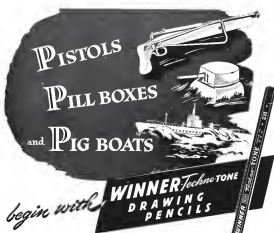
The new manufacturing techniques, and new ways of coupling extreme precision with mass production developed by the plant of Foote Bros. mean more and better aircraft and naval engines. These same lessons applied to the world of tomorrow will mean better machines, more compact and more efficient machines produced at costs that promise greater savings to America's manufacturers.

FOOTE BROS. GEAR AND MACHINE CORPORATION  
5541 South Western Boulevard  
CHICAGO

# FOOTE BROS.

Better Power Transmission Through Better Gears





Find it was no idea—nobody in the...

Need a rough pencil sketch.

Then a few of drawings, renderings and blueprints.

Finally, a gleaming instrument of steel shagging it out with the easy.

Multiply this by infinity and you get an appreciable idea of the pencil work that goes into Uncle Sam's War Productions.

That WINNER Techno-TONE Drawing Pencil has been an indispensable factor in much of this work is an established fact. Established, too, is the preference of Grafton for this precision-sharpened pencil... for its soft, free smotherness, its flexibility, unswerving rich black uniformity of tone. You are welcome to try a free sample. And tell us the degree you prefer.

Write Dept. A-12, A-W Faber, Inc., Norwalk, N. C.

**A-W FABER Inc.** NEWARK, N. J.  
13c each 2 for 25c \$1.25 dozen  
All 48 states and parts outside U.S.A. and special packages

**Continued from WINNER**  
The Grafton Drawing—do  
each other and through  
Grafton to all parts. (20)  
But (10) (10) (10) (10)  
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about (10) (10) (10)  
about (10) (10) (10)

**WINNER Techno-TONE**  
is available in 17 standard  
grades from 4B to 1B  
and in 10 special grades. Pencil  
is made in the U.S.A.

AVIATION December, 1942



# ANY Inexperienced PERSON

## Can Operate an Ozalid Whiteprint Machine

MISS ARCHER was hired yesterday... and she's already operating the Ozalid Whiteprint Machine at top efficiency... making whiteprints of engineering drawings, charts and letters in seconds.

This illustrates how Ozalid DRY DEVELOPMENT has revolutionized printmaking—transforming what was once a tedious job into a simple routine. You merely feed the original and the Ozalid sensitized material into the machine. Two quick steps—Exposure and Dry Development... and you have positive reproductions which are ready for immediate use in the shop or field.

Compare this simple process with blueprinting which demands the services of more than one trained operator to check water trays, potash baths, temperature of drying drums, tension of rollers... in addition to other wasteful operations which throw prime production off stride.

Follow the example of thousands of manufacturers who have been convinced of Ozalid's superiority. Install a compact Ozalid Whiteprint Machine in your drafting room. You'll be sure of a "head start" in war production... and savings in labor and materials.

Write for "Simplified Printmaking" which completely explains the Ozalid Process.



**SIMPLIFIED PRINTMAKING** is an illustrated booklet explaining everything there is to know about the Ozalid process. It shows how to accurately reproduce drawings, charts, letters and blueprints on white background, making printing with the Ozalid process for subsequent print production.

**Ozalid Products Division**  
GENERAL ANILINE & FILM CORPORATION  
JOHNSON CITY, N. Y.  
OZALID IN CANADA—HUGHES OWENS CO. LTD., MONTREAL

## Electronics—Secret Weapon of War

*Persuader of a New Scientific and Industrial Era*

**T**HE END of World War I left scientists with a new playing. They did not know it at the time but they laid their hands on a revolution. Within two years the world had radio broadcasting. Within ten years the whole art of motion pictures had been transformed as talking pictures replaced silent movies. Within twenty years television was born and people were seeing pictures as motion by radio.

The fulcrum of this revolution is the electron tube, a new tool of illimitable possibilities. One form of the electron tube is the familiar radio tube, the much publicized electron eye is another. There are many other forms, each having distinct capacities for saving time, saving energy, saving money, protecting life, limb and property.

The electron tube puts the electron to work—and the electron is the basic building-block of the universe.

Electronics is the new art, the new science of putting the electron to work. Radio and sound pictures and television are aspects of electronics, but there are many other facets of this revolution which have been brewing since the last war.

The electron tube has a typical American family tree. Edison made the basic discovery of the "Edison effect" some sixty years ago. This was followed by the invention of the "Flaming valve" and the "de Forest grid." Then Armstrong contributed his share, and hundreds of engineers in garage and cellar workshops and in the great research and industrial laboratories went to work on the tubes which employ electrons. The tube was a plaything before the last war but the world conflict brought it out of the toy stage and made it a practical, powerful tool.

Today the electron tube is guiding the defenses of the greatest armies and fleets ever engaged in the history of the world.

It is a part of the nerve center of the battleship, directing its course, finding its adversaries, broadcasting running accounts of air battles to its crews, directing gun fire and determining ocean depth.

In the air it is the means of locating and identifying enemy planes, plotting planes automatically, giving concentration from plane to plane and to shore. It is even operating the controls of the plane

in the maneuvering task, in the officer's car, on the back of a foot soldier it transmits and receives vital messages from every unit of the fighting force.

Along our borders, and those of our Allies is an electronic screen which counts, follows and identifies enemy planes a hundred miles away through darkness and through fog.

In industrial plants there are electronic counters that associate passing articles faster than the eye can see; automatic sorters which discard defective, oversize, undersize, off-color articles; automatic control devices which inspect the inside of things which the eye cannot see, controls which protect workers, controls of temperature, smoke elimination, intruder alarms, automatic controls for whole batteries of machines.

In its October progress report on American industry, the War Production Board points out that the radio business is five times greater than a year ago. From 20 million dollars a month last fall, it has increased to well over 100 million dollars a month. Unfilled war orders are in excess of 4 billion dollars.

From such vast growth will emerge a new engineering of products which will immeasurably improve our peace time living.

After the war broadcasting will be infinitely more satisfactory; radio receivers will perform with a new fidelity which will amaze us. Television reception will be as fluid as the motion picture. Present secret war developments will readily be convertible to peace-time devices that will improve our standard of living.

No longer will ships collide with other ships, with icebergs or the shore. No longer will tanks collide and arrest cash in flight.

Garage doors will open as we approach and automatically close themselves. Electric lights will automatically go on and off according to our wants and needs. Farmhouses and homes will be controlled and smokestacks will cease to belch wasteful smoke. Air will be made dust free and grain free. Food contamination will be checked, meat made tender.

Crossings will be made safe and auto traffic will be automatically controlled.

### Putting a "Bobcat" Through the Jumps

Hard-battling U.S. bomber pilots know how to make smooth landings. But during transition training they're concerned about other things. So the Corsica "Bobcat" used for this job needs check areas that can take hard jolts — shot will cushion vertical contact, assure smooth, even landing.

"BENDIX PNEUMATICS" equipment does just that. Proved? Its use by Corsica... leading U. S. producer of traditional bomber pilot trainers.

Built into every seat of "BENDIX" landing gear, wheels, brakes and shock struts, its precision design, skilled craftsmanship, and rigid inspection and test. That is why planes of tomorrow, like so many of those today, will land on "BENDIX" gear.

"PNEUMATICS" Shock Struts and Airframe Attachments built by Bendix Products Division are expert producers of "The Invisible Arm" — the portable equipment built by all Bendix plants from coast to coast and around the world, for fighting today and every day.



THE INVISIBLE ARM

Pneumatic  
Equipment

**Bendix**  
AIRCRAFT CORPORATION

BENDIX PRODUCTS DIVISION

Medical science sees new wonders ahead. Already it is possible to see "winders" on germs, germs which heretofore had been but a blur when viewed through the strongest optical equipment available.

Today so much secret development is going on in the ultra-high-frequency field that little can be said of its great future. But, without divulging military secrets, it can be said that ply-wood is being dried electronically in minutes instead of hours. Ultra-high-frequency welding (not to be confused with those welding controlled electronically) is being done disarmingly and efficiently.

Ultra-high-frequency heating promises to revolutionize the baking industry—let us hope that our houses.

What is this miracle working tube that can see, hear, taste, feel and smell a thousand times more sensitively than was possible heretofore?

What is the electron? No one knows, not even the scientists who know how to employ it. Electron cannot be seen or felt, but if 500 million million electron beams are pushed through a 100-watt electric lamp per second, it will light up to full brilliance. For electric current merely is a mass movement of electrons. Each electron carries its share of electricity, and since the electron has so little weight it can be moved easily and quickly. Therefore, electricity transported by electrons can be turned on or off with great ease and speed. The electron tube merely is a device that controls the flow of electricity. It is a amplifier of power which can be made to do wonderful things. The sound of a terrific geysering mass of a lag can be amplified a million times . . . 50 a rate that can be heard over great distances.

Cases can be classified and matched to a degree not possible by any other means.

Chemical or vitamin consistency can be recognized by coating metal activity within the subject being analyzed.

There is no industry in which electronic circuits cannot be used to speed up production, to increase accuracy, to do heretofore impossible tasks of collaboration and measuring.

The opportunities afforded the engineers who are developing this new "electronic age" are limitless.

Today the electronic industry is 90% at war. It

is meeting the exacting demands made upon it.

Never before was electronic equipment called upon to withstand temperatures ranging from 75 degrees below to 150 degrees above zero Fahrenheit. Never before did cables and transmitters have to withstand the shaking and abuse to which they are being subjected today.

War demands have called for much redesign, much change of materials and a new conception of operating to tolerances never dreamed of in peacetime instead. As a result, electronic parts and equipment makers are building better devices.

Universities and colleges are working at top speed to produce electronic engineers, for every radio operator in a plane, every radio man in the ground forces and on ships, every man operating radar equipment or electronic control devices in an airplane . . . and there are many thousands of them . . . must be a trained technician.

The wall of military censorship is high but it is no secret that one of Britain's best weapons that keeps the Luftwaffe from exterminating London is a radio locator, a device that gives alarm of approaching planes long before they can be seen with telescopes. Scanning the heavens continually the locator warns of the enemy's advance. In the case of a night fighter, the locator informs pilot and gunner when the enemy is within range. Neither is it a military secret that gunfire can be controlled by electronics, and that electronics is having a big share in training our new armies.

Necessity drives a veil over the most dramatic uses of electronics in warfare, but among those who know there is nothing secret about the fact that many of today's wartime applications will revolutionize our peacetime lives. Electronics will invade every industry with totally new devices and machines. The future of the electronics industry is limited only by man's imagination.

Such is electronics, and its destiny!

*James H. McGraw, Jr.*

President, McGraw-Hill Publishing Company, Inc.

## The War Is Not Yet Won

THE CIVILIZED WORLD has been electrified by the brilliant beginning of the North African campaign, which has thrown the entire into confusion and exposed the long strategical self-consciousness of our French Allies. Our strategists have demonstrated that they have learned well the complicated technique of thinking and our tactics have added something new to its enormous ability to make an occupation stick by careful diplomacy, preparation and by making friends of the occupied populations.

The success of these operations are due to a large number of factors, among which are adequate land, sea and air power deployed under conditions favored by timing, surprise, and diplomacy. But it must be remembered that the effective strength of our remaining forces depended chiefly on the degree to which they were opposed. And whether we have to meet still or unopposed opposition depended largely on the diplomatic preparations for the attack.

Our experience in the North Africa adds to the rapidly accumulating evidence supporting our appreciation of the realistic place of air power in the warfare of today. Like all other war machines, the airplane has its limitations, and, if we are to use it effectively, we must use it within the framework of these limitations. An adversary still remains the essential ingredient of victory. Without it, defeat is inevitable. But it must be coordinated with all of the other ingredients if we are to have effective striking power.

An enemy needs of three fundamental elements—planes, men and bases. All three must be at the right place at the right time. The planes must be suited to the particular job in hand. It is most important that the plane is the man who flies it. It takes 30 years to "grow" a pilot. Some of our factories can build an airplane in not much more than 20 minutes, but there is nothing more fragile than a pilot and airplane without man and without a place from which to take off. Whether the base is the deck of a carrier, or the end of a landing route to a jungle air field, it is absolutely necessary to air power.

This is not the time to shout loudly about victory. It

is the time for hope, but not over optimism. There is much more to be done.

To quote the gifted phraseology of the British Prime Minister, it is only the "end of the beginning." Our forces are still a long way from Berlin and we must not underestimate the strength or confidence of the enemy when we are only now meeting.

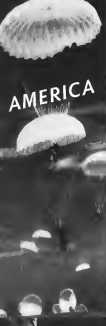
Much depends upon the facility with which we are able to complete the occupation of that small but highly important strategic section of the North African coast which lies between our forces and complete control of the Mediterranean. When this is done and when the elimination of the North Africa Corps has been completed and our plans consolidated, we shall be in a highly advantageous position. Hitler-controlled Europe will be almost entirely surrounded.

THE next move will be the one in which air power will play the most important part. Whether or not it will be possible to force a decision by continued and increased attacks from our completely disposed bases remains to be seen. But no matter how intensive this air action may be, it is probable that it will have to be accompanied by naval action and followed by land operations.

All of our present advantages may be rendered ineffective if the enemy is successful in interfering to any extent with our long lines of communication and that is probably what will be attempted. And our efforts will always be hampered while we have other important work to do in the Western Pacific.

Our still small advance effort has gotten off to an excellent start. The criticism of our strategy was sound and the tactical execution so far has been excellent. Now more than ever we of the home front must cast aside differences of opinion and petty jealousies and lend every effort to give our advancing armed forces all the support that they need.

*Yeshie E. Hinkle*



A BOMBED FRONT has been opening up with prospects as bright as a lot of possibilities in the long hours in military history.

The occupation of North Africa was more than a contribution to this—winning all the odds against an outside factor as a prize—because it marked the perfect blending of all the elements of modern war: man, material and deployment.

The first element revolutionized was the part played by air power. In fact, pre-occupation diplomats referred to a measure the need for faster land border aircraft and at the same time provided adequate bases for the kind of fighting which has been. All airplane war—air, land and sea—was a tremendous field in one of the greatest international power players, Secretary of State Cordell Hull.

Several days in air power's opening role were revealed by the occupation, however. One view in the road was the obvious and the expected. First, major leaders participated under the direction of Brig. Gen. James Doolittle, who took over in command of one of those when the country might be wounded in a battle with French fighter planes. American attack planes, perhaps including some medium altitude fighters, were on the job, as in others for reports of support and ground troop striking. More significant, though, was the fact that land-based American fighter planes were flown into action from England, a distance of at least 1,400 mi. That fact alone was surely more than Hermann Goering will, more and more, be

American paratroopers got their first training in England just before the African campaign in which they participated with remarkable success. They had been based at an English base from before their paratroops were recruited. A good indication of what they are doing in the field is given in the fact that United States paratroopers were flown to American planes down from England in the North African campaign.

From American, Inc.

## AT WAR

**Second front opening gives several clues to the part American aircraft may be playing in future battles, not only in Africa but on the continent.**

significantly in some respects in several dimensions of war, giving no place for an and an important in the fact that paratroopers "the air" after having been flown direct from bases in England.

This is something when we remember that Germany alone started the war with the only air force in the world capable of massive fighting. All the other's halfhearted had no other force, but Germany alone seemed to have a clear concept of aviation reality. The need had to be met and built at the war time.

Whether the first was a success or a failure in having the basic design of a fighter, the *Sturzk*, which would take the lead in attacking their enemies from above, and provide the north side a period in the North African, provided plenty of the side exposed to itself.

But the world turned rapidly from the North. Russia, America, England, Japan—all the fighting systems as well as Germany's. There has been a lesson in the people should learn from it. The lesson is that, if they can a victory in their number, they should also use to launch their side, either in a self up and into the air. As the world looks, and its language is so fixed in the mind.

Since we had agreed on the globalizing battle of air, the United States have obtained unexpected air opportunity on all fronts. They were Africa, Russia, the Southwest Pacific, and the English Channel. It is the evolution of aircraft which have been discussed here before. Months ago, the United States alone joined the entire Axis in the production of an enemy. That, plus the output of the British manufacturing, certainly seemed as if it should also contribute the result. But, as was pointed out, the enemy's air fighting from inside his territory, on its ground, with its divisions and its military camps and its bases was not the Axis were meeting, standing and coming around the other, as it took a lot of equipment to make a few in more different places.

But a woodpecker can still see trouble with war if you give him time. The British and the Chinese, and the Americans and British have provided that time. One day it shows has told up those many spots, and we are now coming in to force and hitting the enemy. His is better back, but the latest production of Japan and Germany are no match in the long run for the strength of the Axis with three-fourths of the world's man-made and resources.

We are told no good soldiers there are the Axis will never again have control of the air for very long,

and any military side, in the war. The War Production Board's sign were and before the other battle, and the last battle up.

So, for the first month, the output of airplanes has been increasing on a nearly level basis. Recently it fell off. Production was better than it looked, however, because the rate of output planes declined in relation to heavy bombers, which don't count up so fast. Actually, the tempo and the other side of the phase did narrow somewhat, but not enough.

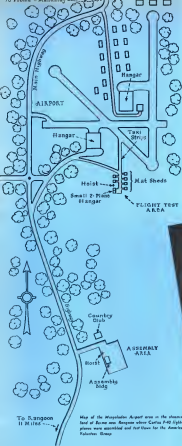
The country is not moving its place ahead, but that is only part of the story. The military men have decided that the warplane program should be more more changed. They must make more, more and, better ones, more sophisticated, longer range, more powerful. The job is just as much harder as if they asked for thousands of more airplanes.

The War Production Board is allocating the aluminum and the copper and the steel and the manpower to the job. The Army and Navy will get what they want, but the coming years about the number of planes may be expected for a while. That number will be increasing as power is going out. That can be seen from reports of Boeing B-27s and Consolidated B-24s going out to fight off overseas of more planes, drop their loads as rapidly and effectively, and get back.

(Turn to page 122)

Presented in the new from the European front of air was recently has been the new de Havilland "Wasp" light speed reconnaissance fighter which first made headlines in the new de Havilland "Wasp" in July. It was a small but a surprisingly 1,000 mi. Of off-road construction, the "Wasp" has a span of 34 ft 2 in., overall length of 40 ft 9 in., and height of 13 ft 2 in., and is reported to reach 100 mi. cruise and has 1,000 mi. range. The speed has not been revealed, but the new de Havilland "Wasp" is reported to be the fastest of its kind. It is reported to be the fastest of its kind. It is reported to be the fastest of its kind.





Map of the Weizhuoban Airport area in the changing hand of Burma near Rangoon where Curtiss P-40 fighter planes were assembled and test flown for the American Volunteer Group.

Assembling and testing fighter planes for action thousands of miles from the factory under staggering climatic conditions and with native labor and equipment is a job that calls for ingenuity and imagination. The remarkable performance of the AVG against the Japs in Burma was fully matched by men who assembled the planes for the Group to fly.

## ASSEMBLING And TESTING P-40's In BURMA

By BYRON A. GLOVER  
Test Pilot, Curtiss-Wright Corporation



FIG. 1. American Volunteer Group passing in review a fuselage built from one of the two fuselages apparently built in India and the plane section from the deck in the assembly area.

IN APRIL, 1941, I was engaged in test pilot by an American company which had contracted to assemble, finish, test, and deliver to the Chinese government 308 Curtiss P-40 (Tomahawk) fighter planes. These planes were later used by the American Volunteer Group to defend the Yunnan River, and assembly and delivery was performed in Rangoon, Burma.

I left Los Angeles in May for Hong Kong by Pan American. (Copper Corporation was made after a two-day delivery with Chen National Airways.) The flight from Hong Kong to Chungking was made without event although the first part of the trip was made over territory held and controlled by the Japanese, and intervals were made only at night or in "darkwater" waters.

The Chungking airport is unique. It consists of a long, narrow landing strip in the center of an island in the Yangtze River. For certain periods of the year it is under water when the river is at flood tide, and for the reason the runway is paved with logs about 18 in. x 6 in. x 3 in. thick. On the day I was coming to Chungking in London Burma, I received word that engine benches had been for testing planes by the Chinese government at the Kweichow airport.

The last leg of the flight was from Luchow to Rangoon, Alvin Kiser in call air at 22,000 ft., the highest level of 135 to 145 deg. in Rangoon was being going. I was told that conditions in Rangoon from the level would be affected when "the main area"—and this goes on to be so. The thermometer dropped 100 deg. to 85 deg. and returned there with the end of the rainy season in October.

The Rangoon office was composed at the time by 20: then P. Gaudin



FIG. 2. A group of Chinese engineers in charge of assembly operations. These men did a tremendous job and directed operations with unusual skill and intelligence.

His staff consisted of about a dozen people whose names were in Rangoon from Mr. Gaudin. I learned that the company had already secured a small piece of land near the Chungking airport and had built a contract for the construction of a small assembly building. The contract had been given to Gaudin & Gaudin, a local contractor. It had originally been planned to use the roof trusses of the assembly building for housing the fuselages of the engines during assembly. Upon checking over the plans for the design of the assembly building I discovered that the roof trusses as originally planned were not strong enough to carry the weight of

the P-40 fuselage. Mr. Gaudin and I then had a conference with the contractor, who upon hearing of the impossibility agreed to replace two of the wooden truss members of the roof using each end of the building with two steel truss members that would be capable of carrying a load of over 2 tons each. Construction of the side walls of the assembly building had just been started at this time and it was estimated that it would require approximately two months before the building would be completed.

Since the P-40's were expected to arrive before the building would be completed it was decided at this time to

Item	Part	Qty	Unit	Remarks
1	Steel plate 1/2" x 12" x 12"	1	pc	For base
2	Steel plate 1/2" x 12" x 12"	1	pc	For base
3	Steel plate 1/2" x 12" x 12"	1	pc	For base
4	Steel plate 1/2" x 12" x 12"	1	pc	For base
5	Steel plate 1/2" x 12" x 12"	1	pc	For base
6	Steel plate 1/2" x 12" x 12"	1	pc	For base
7	Steel plate 1/2" x 12" x 12"	1	pc	For base
8	Steel plate 1/2" x 12" x 12"	1	pc	For base
9	Steel plate 1/2" x 12" x 12"	1	pc	For base
10	Steel plate 1/2" x 12" x 12"	1	pc	For base
11	Steel plate 1/2" x 12" x 12"	1	pc	For base
12	Steel plate 1/2" x 12" x 12"	1	pc	For base
13	Steel plate 1/2" x 12" x 12"	1	pc	For base
14	Steel plate 1/2" x 12" x 12"	1	pc	For base
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19	Steel plate 1/2" x 12" x 12"	1	pc	For base
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24	Steel plate 1/2" x 12" x 12"	1	pc	For base
25	Steel plate 1/2" x 12" x 12"	1	pc	For base
26	Steel plate 1/2" x 12" x 12"	1	pc	For base
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32	Steel plate 1/2" x 12" x 12"	1	pc	For base
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62	Steel plate 1/2" x 12" x 12"	1	pc	For base
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98	Steel plate 1/2" x 12" x 12"	1	pc	For base
99	Steel plate 1/2" x 12" x 12"	1	pc	For base
100	Steel plate 1/2" x 12" x 12"	1	pc	For base

FIG. 3. Steady step assembly operations were followed as a standard lathe was used (limited on both sides) with space provided for inspection and experience retention as each step was completed.

FINAL ASSEMBLY INSPECTION RECORD			
Serial No.	Step No.	Step No.	Customer No.
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10
11	11	11	11
12	12	12	12
13	13	13	13
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18	18	18	18
19	19	19	19
20	20	20	20
21	21	21	21
22	22	22	22
23	23	23	23
24	24	24	24
25	25	25	25
26	26	26	26
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29	29	29	29
30	30	30	30
31	31	31	31
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34	34	34	34
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36	36	36	36
37	37	37	37
38	38	38	38
39	39	39	39
40	40	40	40
41	41	41	41
42	42	42	42
43	43	43	43
44	44	44	44
45	45	45	45
46	46	46	46
47	47	47	47
48	48	48	48
49	49	49	49
50	50	50	50
51	51	51	51
52	52	52	52
53	53	53	53
54	54	54	54
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59	59	59	59
60	60	60	60
61	61	61	61
62	62	62	62
63	63	63	63
64	64	64	64
65	65	65	65
66	66	66	66
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82	82	82	82
83	83	83	83
84	84	84	84
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92	92	92	92
93	93	93	93
94	94	94	94
95	95	95	95
96	96	96	96
97	97	97	97
98	98	98	98
99	99	99	99
100	100	100	100

each construction of a number of small details that could be used both in assembly and in working on the landing gear and in checking landing gear operation after assembly. I designed a simple hand assembly of an inverted U-frame built out of steel I-beams and in conjunction with a 24-ton chain hoist fastened to the center of the tip (Fig. 6). These frames were tilted slightly forward so that they would clear the leading edge of the wing, and they were braced on either side by two steel cables which were anchored to the bare metal steel I-beams forming the fast of the frame. This type of construction was simple and cheap to build and could be salvaged almost 100 percent after the assembly operation was completed. These beams were located in the assembly area just outside the assembly building, and others were located at the support proper, where the flight test operations were to be carried out. Another problem to be solved was to find some way to get the large and

heavy airplane center from the docks out to the assembly building 11 mi. north of Bangkok. The box containing the fuselage and motor was approximately 20 ft. long, 18 ft. high, and 6 ft. wide and weighed just under 5,000 lb. The box containing the wing was approximately 40 ft. long, 18 ft. high, 5 ft. wide, and weighed approximately 3,200 lb. Obviously, none of our standard trucks they probably could handle the job of taking these units out to the assembly

building. There were in Bangkok at that time many of truck, assembly plants and truck body manufacturers who were locally engaged in assembling trucks that were to be used to transport supplies over the Burma Road to China. We needed at least two large truck bodies, and knowing the way they would drive to be, we took our problem to one of the large truck body manufacturers who worked up a satisfactory design and built them in a month. (Fig. 1)

They saved the purpose very well and were much changed all to a local operation after our assembly operation had been completed.

#### Labor

Then came the problem of obtaining labor. Our company had previously been operating on a small assembly plant in south-western China so we arranged to borrow a skilled American aircraft foreman by the name of Andrew Sargent and a group of 175 trained Chinese repair workers (Fig. 2). These men had had previous experience on other types of airplanes, but had never seen the P-40 type of airplane before. To meet them in the operation I prepared and had printed a quantity of standard letter size cards on which were printed each individual step in the assembly operation as it was to be carried out. (Fig. 3) By the side of each card was a place for the signature or stamp of the crew representative who performed the job and for the inspector who followed him. There were places on the top of the card for signature and airplane number and other pertinent information. As each airplane was assembled a card was filled out and attached to the airplane, containing with it a card the airplane was finally delivered to the airport for flight test. This system worked out unusually well as practice, and was of great assistance both to the workers themselves and to the inspectors who put their hand O. K. on the airplane.

#### Assembly Procedure

When these items were loaded on our trailers at the docks and transported to the assembly area, all further unloading and loading operations had to be carried out with manual labor. For work of this nature we employed a large number of Indian coolies. (Fig. 4) When the boxes arrived at the assembly area they were divided off the trailers into the ground, and centers of wooden ball ropes tied to the top of the trailers to prevent them from toppling over as they were unloaded. (Fig. 5) When an airplane was needed for assembly the top and sides were removed from the crate containing the fuselage. The bottom of the crate was left on, as it was attached to the fuselage with its angle iron framework. Sections of 4 in. pipe were used as rollers and the fuselage was then rolled and shifted into place under one of the landing houses. (Fig. 6) The fuselage was then attached to the nose of the motor mount and the airplane hoisted into the air. With the fuselage a few inches off the ground, the bolts attaching it to the landing gear of the nose were removed and the bottom section

FIG. 2. A group of Indian coolies employed for this urban test of unloading the airplane crates at the assembly area.



FIG. 3. The crates were unloaded by means of slides from the trailers. The sliding wooden cables used the cables from the slide and kept them from toppling by means of signs.



FIG. 4. The tops and sides of the fuselage crates were hoisted off, and the fuselage itself mounted to the bottom of the crate was rolled up by its hook.





# IT'S LIKE THE OLD SHOE— IT FITS

A leading executive tells why airline maintenance is as good and better now than ever before.

By PAUL E. RICHTER, Executive Vice-President,  
Transportation & Machine Air, Inc.

HERE IS HOW THE nation's airlines are able to carry on successful, safe-flight operations, yet keep maintenance and safety standards at their maximum levels even higher than before Pearl Harbor.

Master craftsmanship, plus familiarity with tools and time equipment—the DC-3 transport!

The "how it's done" question is one most frequently asked airline operators. In my opinion, the answer is the simple one stated above. This type of transport, which has been standard on airlines for a number of years, is like the old shoe—it fits.

The time mechanics who spend our years waiting on model-T cars know just about as much for every car as we do. Through years spent on DC-3 equipment, our maintenance crews, like you, have become familiar with every nut, bolt and screw on the transport, which have proved their soundness and reliability in virtually every part of the world.

All the "hops" were removed long ago. The maintenance approach, through these years of experience, knows exactly what adjustment is necessary. Jobs are better organized so there is no lost motion. Through unceasingly efficient procedures, the crew knows just when the next plane will be in the hangar and just what operation is necessary to keep it at peak performance.

It's because it is our positive duty to every airline owner to keep our equipment available and operate that equipment more hours daily and at the same time continuously meet our high standards of maintenance and safety.

To operate our planes longer hours,

more rapid turnaround of our aircraft is necessary and our maintenance and repair procedures have been of great benefit in this regard. In order to keep an even flow of maintenance and overhaul operations coming into our shops, the planes are scheduled in such a manner that a large number of major changes and service operations will not fall due at the same time.

In addition, TWA is performing a system whereby mechanical personnel at terminal stations are trained as mechanics. To a certain extent, this system minimizes the man-hour, but it reduces the time a plane is tied up for maintenance.

During the month of September, 1943, maintenance and overhaul work required a total of \$7,700 man-hours in the case month then over the maintenance total \$4,942, although we were operating considerably less equipment, proving that safety standards have not been lowered.

The maintenance program at our principal stations, New York, Pittsburgh, Chicago, Kansas City, New Orleans and Los Angeles, totaled \$68 in November of 1941. In November of this year the total had jumped to 1,305 at these stations. These operations were organized entirely on the basis of commercial planes at all stations except Kansas City. At the latter, the crews spend some time overhauling government-owned equipment. Towed aircraft are maintained at all other stations along TWA's customer system.

Although our management staff has been reduced 42 percent to meet the needs of the industry, our higher standards of maintenance have made it possible



Holder of transport pilot's license No. 201, with more than 2,000 logged flying hours, Paul E. Richter, executive vice-president of TWA knows where to spend when it comes to maintenance.

for us to hold the decrease in revenue and plane mileage to 33 percent. During October, this year, for example, we flew 1,347,617 revenue plane miles in our commercial operations compared to 1,745,528 in October of 1941 when we operated 43 aircraft miles as against 25 this year.

Proof that maintenance standards at TWA are higher than ever before can be found in a comparison of slight flight delays owing to minor mechanical adjustments. In last winter's operations, mechanical delays averaged us every 21,800 sq. ft. down, while in October of this year the average was one delay in every 16,000 sq. ft. a reduction in

duration of increased maintenance efficiency.

Our DC-3 fleet was scheduled to operate 11.14 hours per plane daily in October, 1943, equalling the high efficiency figure attained in the operation of our planes fleet of the Boeing Stearman. The 44 passenger Stearman, which TWA held up domestic service, have been operating for the attack in Far East theater service since last March.

Even our structural shop has been removed from the planes so there are no extra structural loads of wire mesh and passengers. In October, this year, for example, TWA utilized 90 percent of space available in its fleet. This includes passenger baggage and mail. Our expense period under the same month of 1942 shows an increase of 4.51 percent over the corresponding period of 1941.

Another important factor in our success has been our reduction in our

transport of flight crew and the new kind of flight officers have requirements for carrying the maximum qualifications. One of a group of 56 first officers recently completed by TWA, show that the average solo flight time

After a thousand miles of maintenance during the past year, years of accumulated engine wear there was never any question but what the DC-3 could be depended upon to handle a vast amount of service traffic. One of the principal reasons for this is that it is a maintenance man's airplane—designed for easy maintenance.

Photo courtesy photo



for the group was 10:18 hours, the average age 25.8 and the average engine overhaul was 184.5 as against a scheduled overhaul grade of between 80 and 110. "Very few" percent of these men have had one or more years of college and 38 percent are graduates of an aviation university. The average mileage under 25 years.

In respect to age, it is well to remember that today's new and qualified first officer work have been flying for years and they were able to pick up more

hours on their youth than on experience of those old in years. Many of them have been flying since they were 15 years old. The average total hours of flying experience of our pilots prior to employment by TWA is approximately the same as a year ago. In addition, more training has been provided, including a complete course of instrument instruction.

The longevity of old 201 the father of the Douglas DC-3 transport, which (over in page 325)



# We Learned War Maintenance With the AVG

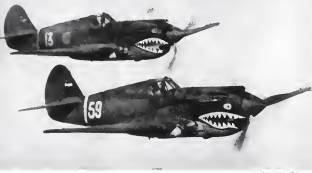


Photo courtesy of Photo

Peacetime maintenance methods apply on the battle fronts up to a point. From there it is a matter of learning the hard way. And you must learn quickly to survive—you must survive to keep 'em flying.

By TYE M. LETT, JR.

Chinese Representative  
Albion Service and Training Depot

GLOBAL WARFARE, regardless the opinion of military school theorists upon themselves of men from the place of its maintenance and the basic need of spare parts, is creating new maintenance, repair, and service techniques and service. Certain basic principles of the all-around effort to "keep 'em flying" remain as good and as sound as in the days when they were evolved in peace-

The author is chief of operational headquarters in China.

time operations. Truths discovered and sustained in combat experience are the same truths, concepts, and the ideas of war as during maintenance, never to be violated.

Building on these truths is the very first operational step of developing a program of maintenance and service in aerial combat. From an issue about the long food, the pattern of aerial operations is likely to change under the operation of war until it seems unlikely it will have little resemblance to its peacetime counterpart. All of this and more are at the Albion Division of Generalissimo, who were permitted to assist in keeping up to fighting standards the equipment of the Flying Tigers of the American Ex-

ercise Group in China, has learned under the stress of battle.

For instance, in the type of warfare waged in that theater of hostilities—and the same will apply in the future, down to the wide of New Guinea, or in French Equatorial Africa—only food kept the all engines and aircraft in use. Not in peacetime would a check, food, fuel, and communication links to the base factors, half a world away, be depended upon to bring up spares and replacements. We learned this lesson because the hard way once when the AVG was downed but one delivery point—Hanoi—and the shipment was not half way done when the Japanese took that port. To the best of the writer's knowledge the shipment was up at Kailash, where we were never able to get our hands on it.

## Home Representatives

On the other hand regardless of the state of the world—whether it was in

of peace—we held representatives coming back on a maintenance assignment would think of losing an delivery without first demonstrating a home representative fully maintained, with the spares problem in the field, who would always be on hand to follow through on orders, to see that they were filled as quickly as possible and so we also that the required materials kept flowing to the area of operations.

This first and basic truth of service we did not overlook when, early in the program which resulted in the creation of the AVG, the Chinese asked Albion to undertake the maintenance for the fleet of Curtiss P-40's, powered with Albion V-1710 C-12's with which the Flying Tigers later celebrated a combat record which has as poor as World War II to date.

General organizational plans for our service mission, which included extensive Washington conferences, were worked out by O. T. Krenner, director of Albion Service and Training Depot.



Photo courtesy of Photo

Depart of maintenance centers was the top to service. Only single ground servicing was performed at the operational field. Generalissimo's order was that "if a plane cannot be prepared for flight within 15 min., it should be withdrawn to a dispersal point for working by other maintenance personnel."

"Condition" was developed in a few years. Now it is no longer regarded as a P-40 without its high value to the AVG as a source of spare parts.

Photo courtesy of Photo



Photo courtesy of Photo

First and Second Albion representatives were jobs requiring less than 15 min. Work beyond this was carried out at special dispersal areas. There is a E. A. Jank of Chicago checking gasoline pump "instruments in Asia."

ment, who had had experience with such problems in the last war.

Col. Chalmers' skills indicated his desire to recruit a unit of United States Army and Navy aviators. When this plan materialized the selected crew chiefs underwent a specially selected Airline training at Indianapolis. These became the nucleus of the AVG ground crew. Later, when Chalmers, most of them American born, who had accumulated experience either as soldiers or portland operators, took on loads of training at Alhambra. It was with these men, who were trained as technicians and emergency loads, that Alhambra found that we could count on real Chinese pilots. These men had military experience and had contact with the assembly and acceptance tests of spare engines, obtained by the Chinese and designed for the delivery of China. All of them still kept good jobs to get their technical skill in the field. Nine of them got through to China and became the backbone of our Third and Fourth Division maintenance and overhaul crews at Kunming and Lanchow.

Not all of these preliminary arrangements we did not forget that all-around factor—the home base trouble-shooter. To fill the role of such a man for our mission (and incidentally because it was a Chinese one) we selected X. G. Lin, a graduate in mechanical engineering from Purdue University. It was Lin's intelligent planning when we were first and his efforts, working around transportation difficulties, and spare delays and the major role of maintenance director, that expedited shipments to the Far East.

Not all that we ordered through his method in and our shipment of engines

and spare parts took 90 days from New York to Kunming, normally a 30-day trip. But that takes us back to the problems imposed by war upon lines of communication, and the hazards of these delays that we should order in the field when we reach a mission.

#### Conclusion

In China we found that it was usually the first two and three that provided supplies; parts like distributor points, small wires, distributor flares, spark-plug, radiator tips and the like—small parts such as these give us the real headache.

To "keep 'em flying" for Chalmers' here we developed the practice of making two double planes out of three or four wooden or damaged ones. This practice we called "household" and we developed it to a fine art. Every time we pulled this trick I read a little prayer for American standardization and the interchangeability of parts, which is a highly-to-be-praised state because of Alhambra's experience.

The "household" has a direct effect upon what you should order from the "house front" and upon what which does coming you there should be prepared to supply too. You in "household" you pick up a lot of various kinds of extra spare parts. A good example is valve springs. As a rule you will get overstocked in them. Also the particular conditions under which your plane are operating and fighting, even in those of the weather, will determine the character of spare material from maintenance. You should have to figure upon this early from the first experience gained in the particular theater in which you are operating.

#### Proper Appraisal of Parts Needs

Another trick of maintenance which requires careful study the stress of war is that a large stock of all kinds of parts is not the answer to efficient field service. It would be better to have a large and varied assortment of the most likely and proven available at the Front and Second Divisions. For these are the parts usually most critical to get a plane back into action in a hurry. These vital First and Second Division parts should always include four per cent. The major parts, except by Third and Fourth Division operations, are provided of larger materials, and where quickly needed you be likely to be out of stock in emergency.

A careful estimate of what parts according to number of planes, of course, more counter to the present unit system of making up maintenance, the number of parts needed to service an airplane for 60 to 100 days, not only planning that figure by the number of days in the operation. You often the feeling is that parts are so vital that it is not as well to have them so, hard though they are to get in certain circumstances. This is an excellent in war-time when every part should be counted in man-hours and material.

Another wonderful practice that comes out from previous experience under extreme lack of supply and demand, is to get 1,000. When by chance, the squadron does get the 1,000—most the 200—there is a terrible unaccounted stock of labor, materials and transportation. And further it should be borne in mind that the squadron which receives the 1,000 units where only 200 were required may be downed in one operation, in another quarter of the globe to correct defect.

#### Disposal Plans

Next we come to the matter of losses, repairs and surplus parts. We originally planned graciously and optimistically to have two outgoing field maintenance operations, four sub-depots and two more overhaul depots. Experience in the field quickly taught us the error of such thinking. On the whole, however, that you should never put all of your eggs in one basket, the more central depot, still can do. A number of more or less central depots should be set up. One of these, containing a large part of the reserve pool, should be located in the back of the main front as possible but at a distance enough, outside of the front by air. The other depots should be so located as to be in position to have knowledge of special conditions and the character of these conditions as they may occur in the war. (Turn to page 300)

# Built to save lives!



**B**ut American planes are also built to save lives . . . the lives of our pilots and crews!

American planes are built with superior armor and fire power—equipped with precision instru-

ments for every possible fight and—to take our men to objectives and bring them home again.

Time after time, guided by instruments they fly hundreds, thousands of miles through pitch black night, through rain and

fog and snow. They surge deep into enemy territory and get safely back to base.

All of which adds up to one important reason why our Army and Navy Air Forces are proving more than a match for the Axis



One of the many technical devices built in the Bureau maintains from which "house of" was obtained. Operational fields were completely changed by methods and plans—despite which it was after so often was given.

Field service operator's work on Fleetwings BT-12 training plane simplified and speeded by cooperation of service and design engineering departments. This teamwork from the beginning has also proved an aid to production.

By J. A. KNOX, Service Engineer and J. J. BOERICKE, Project Engineer, Fleetwings Inc.

IT IS AXIOMATIC THAT an airplane design that is good from a maintenance point of view is also good from a production point of view. If the plane is easy to maintain and service then it follows that it is likewise easy to build production-wise.

With that thinking in mind we designed the Fleetwings basic trainer, DT-12—the first military airplane ever

built principally of stainless steel—where we are building in quantity for the Army Air Forces. As such attention was given to the design stage to the need for ease-of-maintenance of this ship as to the performance characteristics.

We realized at the onset that a basic trainer is in the hangar only a short time, day in, day out, is handled by flocking fliers most of whom have had less than a finished hours flying time, and therefore has to be tough and rugged and easy to service and maintain.

Every airplane designer knows that there are two principal approaches to employ in designing a plane that can be readily serviced. First, an effort is made to incorporate into the airplane parts that are inherently service-free. An example of this is the use of self-lubricating bearings throughout the control system of the BT-12. Unlike plain bearings, these bearings will never require additional lubrication—they are lubricated internally. Another illustration of this point is the instrument panel which, because of the fact that there are no dials to need to be changed in the instrument, does not have the multitude of electrical connections that usually are present. The flow of such an instrument is provided with a flowchart

on the fuselage. The design of the BT-12 is such that the entire cockpit of fuselage, extending from and including the wing leading to the tail post on both sides of the airplane can be removed in less than 5 min., giving ready and complete access from the ground to the engine, accessory compartment, controls, radio and electrical systems.

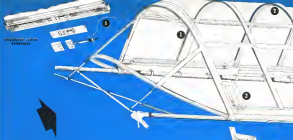
The advantages of this feature are obvious. Consider, for example, the radio installation. If this equipment were to be installed and serviced through the cockpit the job would be considerably slowing down due to the cramped quarters for opening. Another example is the use of disconnect plugs and receptacles in the electrical installation. Use of plugs makes possible separate electrical units, any of which can be handled or removed and replaced in the ship with the greatest of ease. There are no solder connections to remove time and trouble when the plane is being serviced.

#### Metal-Plywood Combination

The fuselage framing is a combination of metal and plywood panels, each of which can be removed quickly by means of fasteners. From a service stand-

point, the result being that the figures appear innocuous in the dark.

The second principal consideration calls for the use of easily removable units, both in the interior and exterior of the airplane. Perhaps the most apt illustration here is the use of large, readily removable sections of flooring



point the plywood panels are very acceptable—almost any woodworker or carpenter can repair them. Airframe parts, other than those fastened and bolted, that do not require frequent and rapid removal, are attached by means of a prefitted nut which facilitates servicing. A special stainless-steel nut cap

is used to secure the nut, and the nut is secured by a locking nutcap over each nutcap and through the nutcap and through the nutcap.

The upper fuselage of the fuselage. The fuselage and fuselage are made of stainless steel. The upper fuselage of the fuselage is made of stainless steel. The upper fuselage of the fuselage is made of stainless steel.

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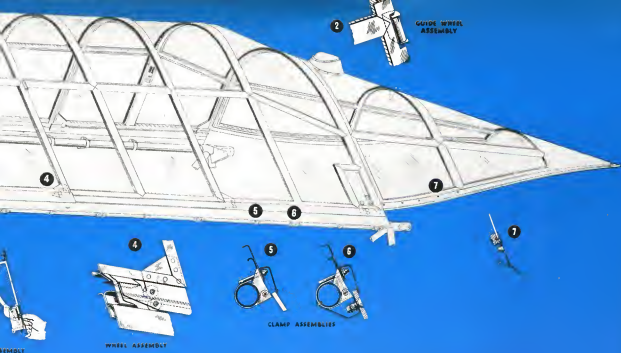
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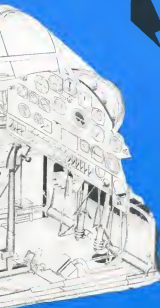


GUIDE WHEEL  
ASSEMBLY

CLAMP ASSEMBLIES

WHEEL ASSEMBLY

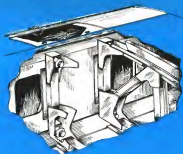
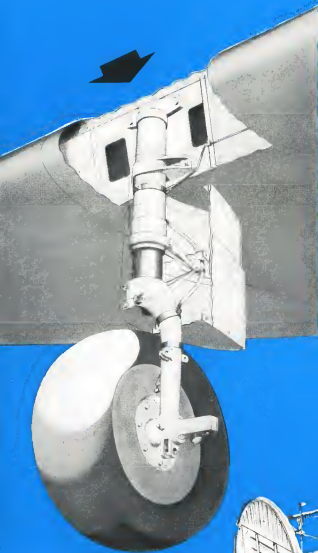
*Cockpit interior:* For servicing instrument panel, panel mounts, and instrument lines of the front cockpit, easy access is provided by removing top sections of the fuselage cowling in front of the windshield. All instruments are readily removable. The main electrical panel is equipped with circuit breakers, rather than fuses, thus eliminating need for frequent fuse replacement. Special attention has been given to the ease of servicing the main electrical junction box which is located on the left side of the fuselage just aft of the firewall. This box is accessible from the ground through a removable panel in the side fairing. It is partitioned to house its allied units which are accessible on removing one cover which is quickly detachable. All conduits are accessible from the outside by removing the side fairings, which is a very easy and fast operation.



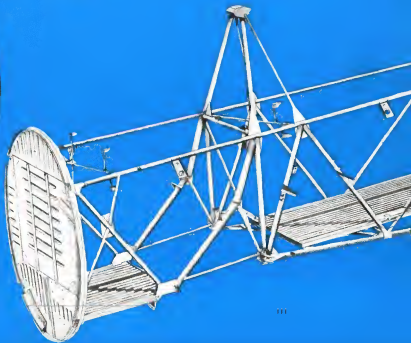
The ring cowl is of strong, tough construction, yet extremely easy to service. It is designed in four sections, any one of which can be easily removed by means of quick detachable fasteners. Ribs are rigidly attached to a chrome-moly steel tube ring, which is in turn, flexibly attached to rocker arm boxes by means of shear type rubber-mounts. Aligning pins have been provided on ribs to expedite and ease the installation of the ring cowl sections.

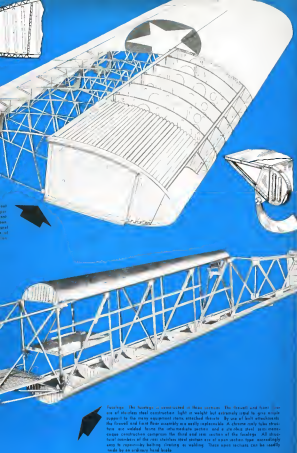


The landing gear of the Hovving's BT-12 has been designed for ease of service and maintenance as well as strength. The cut-away below shows how the gear is attached to the front spar by four bolts through the sturdy fittings. The smaller illustration at top right is a view of the attachment at the spar from the rear, showing how the bolts go through the spar into the specially designed ribs. The upper part of the landing gear fairing is attached to the wing on an angle member and the extruded member while the lower part of the fairing travels with the wheel and shock strut.



The outer wing panel is of stainless steel design consisting of stainless steel reinforced with corrugation. The trailing ribs are bolted on rather than permanently attached to the main spar which makes for ease of replacement. The entire trailing rib structure is readily replaceable because of its type construction. This stainless steel wing illustrates not only the structural qualities of this material for aircraft but also the simplicity of this type construction and shows, as well, its adaptability for modern shop production. The wing tip is of plywood construction and is quickly detachable.





Footings. The footings is constructed in three sections. The forward and stern footings are of standard steel construction, light in weight but extremely rigid to give ample support to the main equipment items attached thereto. By use of built-in members, the forward and stern footings assembly was easily replaceable. A closure only when these two are welded from the intermediate section and a one-day steel gun-mounting construction comprises the third and new section of the footings. All three footings members of the one standard steel section are of open section type, successfully using its compressive loading. During its welding, these open sections can be easily made by an automatic hand tool.



J. F. MARTIN  
Supt. of Maintenance  
American Airlines

R. A. MILLER, Supervisor of  
Overhaul, American Air-  
lines

**American Airlines and Continental Airlines** have been selected this year for AVIATION's Maintenance Award. In keeping with the policy established last year, awards are being made to an airline operating over 100,000,000 revenue passenger miles per year (American), and one to an airline operating less than that amount (Continental). The awards are to be presented to the winners at the maintenance meeting of the Air Transport Association to be held in December.

## American and Continental Win Aviation's Maintenance Award

THIS YEAR the selection of America's Maintenance Award winners has been more difficult than ever before. The fact is that the maintenance departments of all the airlines are deserving of special consideration in view of their magnificent work under loads of great stress. Despite the reduction of available equipment and loss of highly specialized personnel, airline schedules have advanced but slightly and are being kept with amazing regularity. The maintenance function is directly responsible for this achievement.

The engineering and mechanical genius of the maintenance men has come to the fore as a military asset of the first magnitude. Almost every day, in every shop, a new idea, a new method, a new gadget is devised to increase maintenance efficiency and to make quicker turnaround possible. Where more time available in equipment available and more trouble handled, this characteristic initiative sounds heavily when needs for carrier space are so real as in time of war.

Other factors, no less important, include a more efficient routing of ships so that maintenance shop load factor is greatly improved, the use of maintenance specialists which reduce maintenance time and simplify training of new personnel, and rapid adherence to imposed personnel safety measures which prevent maintenance delays.

Apart from keeping what the airline's vital air transport service, which represents a major contribution to the war effort, the maintenance departments have assumed a considerable responsibility in the training of



R. F. JOHNSON  
Asst. Supt. of Maintenance,  
Continental Air Lines



STANLEY A. SWARTZ, Vice-Pres., Engineering and Maintenance, Continental Air Lines

Army mechanics and in maintenance work. In the latter work, the engineering talents which have consistently been a major factor in air transportation progress are now employed in a war production function and can be measured in terms of fastest war material gain.

With their tasks multiplied three-fold, therefore, highest tribute is due

these men upon whom so much depends in time of greatest need and in whose efforts we find a symbol of confidence and security.

Typical of them are the maintenance personnel of American Airlines under Joe F. Martin and of Continental Air Lines under Stanley E. Swartz, whose companies are winners of America's Maintenance Award this year.









Back into the air ever looked—again efficiently and light-heartily! Designed to insure landing to rugged terrain this "Hudson" was quickly dismantled when it first hit the tarmac. Slipped in operation parked status quickly repaired and reassembled by field maintenance crews.

Maintenance of thousands of airplanes depends on steady flow of material parts. Completely equipped mobile units—like this one of Technical Training Command—carry millions of aircraft operating systems, simulate them according to sequence.



## Fighting the AIRCRAFT MAINTENANCE War

THROUGH GRAPHIC "before and after" presentation, the tremendous development of wartime aircraft maintenance may, in some measure, be visualized. And how amazingly the picture has changed since that "before!" Just a month prior to Pearl Harbor, I prepared an article titled *The War and Aircraft Maintenance* (AVIATION, December, 1941) and little did I, or anyone else for that matter, realize that how strikingly soon the perceptions of that study would come to pass.

Then I inked of 12,000 airplanes—today we are on the home stretch to a 1942 production goal of nearly five times that figure! Surely, none but the very best informed can begin to gauge the utterly fantastic amount of planning and work required to keep our airplanes airworthy in condition and ready for combat. Certainly the largest technical job of this war is the national task of supplying and maintaining our airplanes.

Regardless of how outstanding this performance may be or how regretful it may be understated, an airplane is only as good as the maintenance it receives. Our index of production is not



Field problems are solved with "before and after" approach. Here are repair and assembly shops—above and right) of biplane-shaped "Hudsons." Many portable, portable units. Below: "Field van" type—and this plane "had it" intricate mechanical problems are fixed by test battle technique, but factory-based mechanics find answers "on the ground."

the factor that determines how many aircraft can be placed in combat! That factor can only be calculated by an analysis of the number of aircraft in condition to fight—and the fighting condition of an airplane depends entirely upon how well it has been maintained.

Aircraft maintenance has undergone a real change from both the air-line and military maintenance as known a few years ago. Granted, the same fundamental operations must be performed now as then. But now, instead of maintaining a few hundred aircraft within our continental limits, we must maintain thousands of them in the heat of battle, the jungles of the Southwest, in the maws of tropical seas. The global war, and though it may be, has pushed parts of expansion into the arena of a few months.

Where a maintenance problem in the past was the subject of careful deliberation and experimental work involving weeks, we must now make decisions quickly—and act. Our very existence depends on action. And so amazing truth is added when we compare the results of those fast decisions with those past results founded in careful deli-

beration. Our wartime results are just as good now as they were then. Perhaps it is a measure here of our knowledge that leaders along that, we must be right the first time. The planes must be both accurately and efficiently!

In writing of maintenance last year, I stated four cardinal necessities of successful military aircraft maintenance: (1) Maintenance bases and equipment, (2) parts supply and distribution, (3) trained personnel, and (4) transport. There are, of course, innumerable modifications surrounding each of these requirements which, when in detail, would fill volumes. These needs were noted before Pearl Harbor. Now, a year later, it is interesting to note the capacity with which the requirements for each of these major maintenance necessities have been fulfilled.

Here's an example of the speed with which Army Air Forces maintenance bases have been established:

On Dec. 3, 1941, the AAF asked the Lockheed Aircraft Corp. to establish a maintenance and overhaul base in a foreign country. This base was to be

(Turn to page 244)



Score upon score of bases, both permanent and mobile... myriad parts and equipment... air transport to take them anywhere... trained personnel throughout to gather, distribute, and apply them rapidly, accurately. A fantastic order—but the ASC is filling it!

By REAGAN C. STUNKEL

General Service Manager,  
Lockheed-Pope Aircraft Corporation

# Adapting Assembly Line Techniques To Engine Overhaul

Chicago & Southern shop handles AAF training plane engines from eight states; women mechanics among civilian employees relieving Army men for combat plane work.

ASSEMBLY LINE TECHNIQUES are being used in the Army Air Forces motor repair depot now functioning at Chicago & Southern Air Lines shops at the Memphis Municipal Airport. The depot handles Army training plane engines from a territory bounded by Florida, North Carolina and the Mississippi River, taking in eight states. Several of these repair divisions have been set up throughout the country to relieve the regular Army depots of this work and allow them to concentrate on engines for combat planes.

Civilian mechanics, a few of whom are women, are employed on this project and are under direct supervision of both Chicago & Southern and the Army.

The fast first training plane candidate due to motor failure are probably not flies to the thousands of these work. "Chicago & Southern has developed a production line that is now ready to 'click,'" according to Capt. Richard E. Fly, Army Air Forces General Depot representative, through whom often the work is handled. "This is due both to good management and to having good men working on the project. We started this work recently on a small basis and now we are ready for production—to get the maximum number of engines off the assembly line each day. Our goal is to handle some 250 engines per month."

A number of mechanics working on

Assembling a Continental R-600 engine by production line method pass speed through which the line reports to men and up to 100 engines per month. Six of civilian employees, including women, under Chicago & Southern and Army supervision relieve Army Air Forces mechanics for combat plane work.

Chicago & Southern Air Lines shops

the project were trained at the National Defense School, and more now in training there will be employed. As production increases, more and more women will be employed to do this mechanical work, Capt. Fly has reported.

Among the outstanding achievements in connection with this repair depot is the development of a portable motor test stand which saves approximately one man-hour of work per engine. It is the first such test stand of its kind in the United States, and was designed and built under the supervision of W. E. "Doc" Anderson, C & S superior student of engineering.

After the engine is assembled, it is hoisted to the portable test stand and pulled to the specially built test house where the stand is locked into place. Each motor is test run for 5 to 10 min., during which time it is constantly checked by instruments and its performance recorded.

Every 500 to 600 flying hours, each training plane engine must receive a major overhaul, consisting of completely disassembling the engine, cleaning it and inspecting each of its many parts for wear or defects. Worn or defective parts are replaced and the engine is put together again along the assembly line. After the test run it is cooled and shipped.

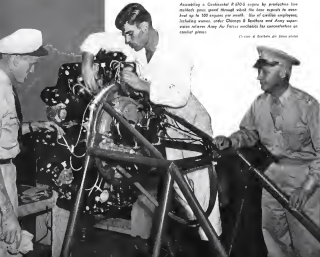
Both the engine overhaul "assembly line" and the test cell are housed in specially built quarters entirely separate from Chicago & Southern's regular maintenance department.

An outstanding development of the engine repair line is the portable engine test stand designed by W. E. "Doc" Anderson, superintendent of engineering, which saves approximately one man-hour per engine. The assembled engine is hoisted to the stand, which is then moved to the specially built test house and hoisted in place.

Continental engines from Army Air Forces training planes meet at Chicago & Southern repair depot by truck or special motor and for shipment back again. Many W-12000 C & S machine supervisor testing of an engine which has just finished its test run after complete overhaul ready to go back into service in an Air Force training unit.



The Army Air Forces engine repair depot at Chicago & Southern Air Lines line now produces line technicians in assembling training plane engines from Army schools in right photo. Capt. Richard E. Fly, AAF representative, watches a cylinder specialist at work in one section of the line. Success of the technique is due both to good management and having good men working on the project, Capt. Fly reports.



# O'er the ramparts we watch

LOOKING down now at our embellished America, it is the spirit of the undaunted men who guided this nation through the perils of the past.

They see our mighty republic, nurtured by liberty and union, menaced now by the guardless oceans, sharks and the ramparts we assumed become masses instead of barriers under the speed and power of attack from the air.

Once, all that courage needed was a foothold for the defense of its hinterland — by possessing its harbors, rivers, oceanic passes and vital points, it could protect the whole.

Then the sailing of the Spanish Armada witnessed our power was full wings and, spread and fed by strategic bases like Hongkong, Singapore, Gibraltar, Manila, Alexandria and Capetown, our power was made to mena world command.

Now as in the twinkling of an eye all this is changed!

Land power and land barriers however formidable are baffled and evasive. Sea power with all its far-flung empire is threatened. The land and the elusive dimension — the nerve of the sky — is now used by the plane, overlapping its land and sea all the barriers of the past.

So the airports we watch are overhauled, and our vigilance more comprehensive: not just the curve of

our shores but the arch of our heavens, and the one freedom crowning and disseminating all others freedom for ourselves and our children is henceforward the freedom of the skies!

We must be among those. Nay, we must be invincible. Immortal Time, now steeped by speed, awaits us. The days of peace we now know by virtue of the slow pace of man and week-long distances of the seas are hatched by the plane in hours.

To preserve America we must make her first in the air — prepared in advance to defend and attack in any point, her strategy secure and unerring, her youth trained, steady, disinterested, their equipment and tactics the very perfection of the newest art in war.

We must be streamlined, fast-minded, world-minded now — get in spirit and strength to the new leadership directly in placing in our keeping — justifying our machines better place and responsibility through justice to all.

In the light of these truths Goodyear is proud to be producing such complete airplanes and airships, as well as wing, and tail cabin subassemblies, control surfaces, wheels, hoses and buffer gear—ensuring perfect service and fuel lines for many of America's most famous fighter and bomber squadrons.

America must be first in the air. Before any other duty Americans must provide the men and weapons to put her there — the caliber we see you are sure of our people our dear children will ever be first in anything again.

AMERICA MUST BE FIRST IN THE AIR. Unless and until America is the most powerful nation in the air, our safety, our freedom, and our standard of living will not again be what they have been in the past.

*Robert R. Goodyear*





After visit to the model B-25 bomber, the direction of two inspections is indicated. One group of field engineers with the idea that will do it in the field. To coordinate field conditions, the men are not permitted to see the time- and labor-saving methods shown by American technicians and other engineers commonly in use on all modern American aircraft. It is said they do it the hard way, or they will have to in the long career of the war.

Frank Lyons (left), field service manager for North American Aviation, Inc., with a personal appeal to the performance and service problems encountered by P-51 Mustang fighters in the European combat zone from Bill Lyons, the company's chief representative in London. Lyons had just returned from the front for a short stop at the home plant to supply his field reports and to bring up to date the new developments for the Mustang.



## Bringing Field Experience Back to the Plant

Three-fold program coordinates manifold jobs of North American Aviation's field service representatives to insure maximum performance of planes on all fronts.

By FRANK H. LYONS  
Field Service Manager  
North American Aviation, Inc.

AMERICA'S WIN-THE-WAR production program, calling for an enormous output of aircraft, has made it necessary for North American Aviation, and the aircraft industry in general, to expand manufacturing facilities almost beyond conception. Yet in spite of the

thousands of airplanes being built in this nation, the tremendous effort put forth to get them into service would be a futile gesture if they were not kept in flying condition. North American therefore established a unit within its organization, whose sole aim and responsibility is to coordinate operational and maintenance information between the home plant and the pilots and mechanics operating and servicing B-25 Mitchell bombers, P-51 Mustang fighters, and

A-16 combat trainers in the field. Then we begin the field service department.

An airplane in the ground is of no value in fighting so in order to keep an airplane in the proper operating condition three methods are employed:

First, by an on-the-spot educational system, as provided by the company's highly specialized and thoroughly trained group of 40 field service representatives who are assigned to posts throughout the world.

Second, by a factory training program for the United States Army Air Force personnel.

Third, by the preparation of flight, service, and repair manuals, which are used by the pilots and mechanics all over the world.

An extensive educational program is provided for our field service representatives, who, during the past twelve months, have traveled more than 250,000 mi and checked up on our airplanes in service in 22 countries. Their training program that they job is two-fold: (1) As just mentioned, to give so-the-spot information on the proper technique for operating, servicing and restoring North American planes, and (2) to report their findings to the home office.

A close watch for any and all signs of trouble is maintained by each man. Operation and service problems reveal by trouble such as the high temperatures of the desert, the effects of humidity in the jungle, or of sand and dust, sea, ice, bugs or vegetation—all of these are reported to the home office. These reports are tabulated and forwarded to the various engineers responsible for the design of the airplane and, if the same type of difficulty is reported from different combat zones, steps are immediately taken to improve the part in question in order to prevent any more of the trouble in planes on the production line.

This procedure has proven extremely helpful in keeping planes in manufacturing in the air, a fact emphasized by reports on their excellent performance in New Guinea, Europe, Burma, and over other battle fronts throughout the world.

The men selected as field service representatives are not picked from among engineers or our pilots who qualify on the basis of their knowledge and experience with our planes. The first requisite is that men be thoroughly familiar with North American airplanes. We therefore prefer that they have a background of engineering experience. This is desirable as our airplanes do get hit by enemy bullets and, even then (Turn to page 22)



# WOMANPOWER

## In Airline Maintenance Shops

By CHARLIE N.  
(penname) JAMES  
Pop-Product, Operator,  
Western Air Lines



Miss Betty Delaney, Western Air Lines' "Airbusman," and one of a married airplane mechanic couple plan for passenger facility changes with Russell J. Smith, manager of maintenance service in Los Angeles, as a Charles Zimmerman (center) chief passenger agent, looks on. Other women are doing

around the maintenance job as electrical and mechanical technicians, radio operators and maintenance clerks. The company's new bureau has been conducted by women who do all phases of its work including job happily.

SINCE LAST DEC. 7 when the United States was plunged into war, one definitely new word has emerged in airline maintenance. This word is "womanpower." No longer is the role of women confined to that of hostess or ticket agent. In our aerial transportation department expansion program, new newly equipped, airplanes have been made for maintenance crews no expert will be 30 percent women.

In less than three months, the nation's airlines saw several United States' end work equipment they had on hand and began a new era in aviation—the use of single lines, supply shops, of rest freight transportation by air, and, of full scale use of women in all branches of the service. Flying

or flying cargo ships to the fighting fronts puts domestic airlines in a dual role, for they still are operating as carriers of priority mail, express, passengers, and mail express, to every civil industrial center of the nation. Moreover, the dual role has added for expansion, particularly of maintenance facilities. There, like all other facilities of war, have to be on a production basis.

To meet this steadily growing problem of maintenance of our equipment, Western Air Lines put mechanics and electricians to work on a proposed addition to existing maintenance shops and a new complete structure to offer isolation for the maintenance department's shops. Further,

There are a number of jobs around maintenance shops that can be done as well or better by women than men. At Western Air Lines special facilities are being established to permit fullest utilization of women for maintenance work.

we have set up a hiring and training program that will provide 100 mechanics during the year.

Because it is anticipated that about 50 percent of those 100 mechanics will be women, the new repair oriented building, for example, is to be equipped with facilities that will permit their use by women. Where equipment will be mounted on rollers and various, special safety devices will protect these new mechanics in case it was not necessary to afford protection before, and new rules have been adopted, among them are requiring women mechanics to wear helmets. Counterbalancing of models tools will be a common practice.

Rest room facilities are being provided and particular

attention has been paid to shadow-free lighting, to reduce worker tension and strain in the long hours of women workers. Whenever possible, no one working from the engine room toward the aircraft's fuselage, who have and women in a greater variety of mechanical jobs than any other industry with which we are familiar.

Already Western has women in its operations mechanics classes and some have been assigned to jobs early before performed in airline maintenance shops by women. One, Miss Mary Russell, for example, in addition to her daily duties, is doing efficient work cleaning shop plugs. Another, Miss Janet Martin, works on instruments. Bill Mueller,

(Turn to page 34)

Frances Dorothy Jorgens (standing), and Katherine Robinson practices radio in the operations department. This department is now entirely staffed by women.



Ann Smith of the engine maintenance shop repairs engine parts and functions in two women's hands. One is recently (right) will do actual work under Smith's direction while the other looks on. And inside the engine will exchange phone in maintenance and repair.



Miss Agnes Martin, wife of a Lockheed Aircraft Corp. industrial mechanic, is an apprentice industrial technician at Western Air Lines. During her training shop she will obtain her fate between the classroom and the workshop.



Muskegon Airport, Jacksonville, Florida, showing National Airlines and U. S. Army Cargo Lines operated by National. *Texaco Aircraft Super Oil is used.*

## SPEEDING THE WAR EFFORT...

### Throughout the Great Southeast



**PROVIDING** 2,000,000 *stat-miles a month* for Army-Navy personnel, war contractors and the general public... Flying U. S. Army Cargo Ships *more than 4,500 miles a day*... Such is National Airlines War Effort... *bringing war plans throughout the Southeast within a few hours of each other.*

For *day flying*, so largely in the interests of our National Government, National Airlines uses *Texaco Aircraft Super Oil*, a performance reflected by the entire industry, is now

More *revenue airline miles* in the U. S. are flown with *Texaco* than with any other brand.

The outstanding performance that has made *Texaco FIRST* with the airlines has made it *FIRST* in the fields listed in the panel.

*Texaco* users enjoy many benefits that can be yours. A *Texaco Aviation Engineer* will gladly cooperate in the selection of *Texaco Aviation Products*, available at leading airports in the 48 States. Please the nearest *Texaco* distributing point, or write *The Texaco Company, Air Division*, 135 East 42nd Street, New York, N. Y.

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★ *When a National Airlinesman or ground crewman in the U. S. is interviewed with Texaco there with all other brands combined.*

★ *When a locomotive and train in the U. S. are interviewed with Texaco there with any other brand.*

★ *When a revenue airline refers to the U. S. are flown with Texaco there with any other brand.*

★ *When boats, more fast lines and more fast lines are interviewed with Texaco there with any other brand.*

★ *When a military ground transport in the U. S. is interviewed with Texaco there with any other brand.*



**TEXACO Lubricants and Fuels**  
FOR THE AVIATION INDUSTRY

TUNE IN FREE ALLEN EMMY SUNDAY NIGHT—CBS 9 HELP WITH THE WAR BY RETURNING EMPTY BURNS PROMPTLY

AVIATION, December 1940

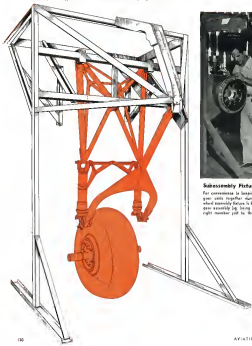


## AVIATION'S MAINTENANCE NOTEBOOK

Sketches, detail drawings and photographs of practical instructions for better and faster maintenance; includes special tools and workstands, tools, jigs, fixtures, jacks, dollies, racks and testing devices.

### For Easier and Swifter Assembly

This jig was built by Eastern Air Lines' maintenance department for complete assembly of Douglas DC-3 landing gear with prior to installation on planes undergoing overhaul. One of the jig's distinctive components around the engine nacelle, thus saving a considerable time in getting planes back in the line. Of related construction, it was built about entirely of the type of material found "outside in the yard job."



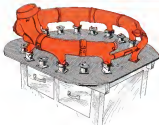
### Subassembly Fixture

For convenience in joining complete landing gear units together during reassembly, this wheel assembly fixture is built into the landing gear assembly jig, being attached to the up-right member just to the left.



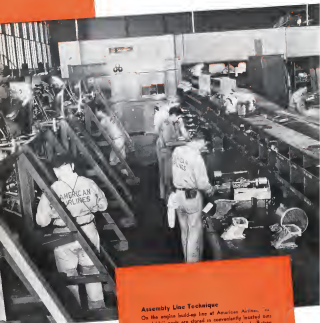
### One-Man Mobile Platform

Extensive machine in outfitting Pan American Airways have been found the mobile one-man ladder installation in quickly reaching high accessible parts of the C-47s. The work platform, complete with guard rails, can be set at any height by means of the crank at left, placed at convenient working height. Note how all four casters can be swung into position for moving the ladder by moving the single lever once below the work.



### Collector Ring Aligning Jig

This four-purpose jig was designed and built to insure accuracy and speed assembly of exhaust collector rings by the TWA maintenance department. One of the jig makes possible the proper fitting of all sections of the collector ring before it is installed on the engine. Thus defective sections may be replaced and properly fitted to the ring and check electric prior to installation. With the proper, precision designed to work with the finished completed ring to the engine build up cover, strong compression around the engine being built up and providing distribution of the coils.



#### Assembly Line Technique

On the engine building line at American Airlines, "suspendable" parts are stored in conveniently located storage racks along the engine line for use as needed, eliminating waste motion in going through repetitive procedures at the storeroom. Broad work stand running the entire length of the line provides space for "subassembly" work with necessary parts conveniently at hand.



#### Portable Paint Stand In Use at American Airlines

Complete with compressor, sprayer, mixing tape rollers and cutter, this completely self-contained paint stand can be rolled right up to the airplane to do practically any type of painting job necessary. Photo at the left shows the mixing tape rolls and cutter, as well as a fire extinguisher.





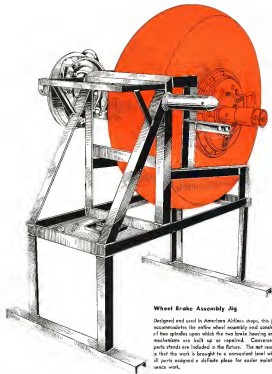
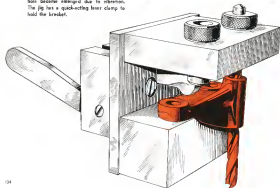
### Rocker Arm Socket Remover

Hydraulic fixture for removing rocker arm ball socket made by Continental Air Lines personnel. The end of this device is fitted to a diameter to fit the rocker arm and by applying pressure to the plunger the oil forces the ball socket out of the rocker arm.



### For Salvaging Cowl Flap Fastener Brackets

A jig for drilling cowl flap fasteners made in the Continental Air Lines machine shop for installation of buildings where formerly these buildings were discarded after the hole became enlarged due to vibration. The jig has a quick-acting lever clamp to hold the bracket.

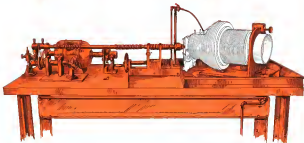
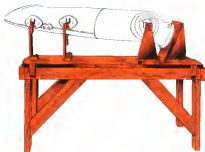


### Wheel Brake Assembly Jig

Designed and used in American Airlines shops, this jig accommodates the entire wheel assembly and consists of two splines upon which the two brake housing and mechanisms are built up or repaired. Convenient parts stands are included in the fixture. The net result is that the work is brought to a convenient level with all parts assigned a definite place for easier maintenance work.

### Echopipe Pipe Repair Jig

Clamping of echopipe fuel pipes at the forward attachment point (due to misalignment of attachment fittings) when repairs were made to the pipe has been overcome by TWA maintenance engineers by use of this jig, which they designed and built. Note that all materials used in the jig are very heavy, this was found necessary to prevent distortion of the pipe during the welding process after the pipe has been captured in the fittings aligned. While in this case a steel was built especially for the jig, it can be used as any kind of wood and should be precision square between joints.



### Speed and Accuracy Combined

This wire grinding machine was built by the TWA engine overhaul department when several wire types had been found and found wanting. It grinds either the exhaust or intake valve in 18 min. The 1-hp electric motor driving the grinding wheel at 4,000 rpm. The shaft which moves the grinding wheel in and out is provided with gear ratios

adjustment for close adjustment of the wheel. The machine is also equipped with a delivery wheel to carry mechanism (one just in front of the motor). A constant flow of lubricant is pumped to the grinding wheel through the line shown just to the left of the cylinder. The fluid which flows through the pan shown just below the right end of the cylinder is thoroughly filtered before being fed again to the wheel.



### Aluminum Control Strip

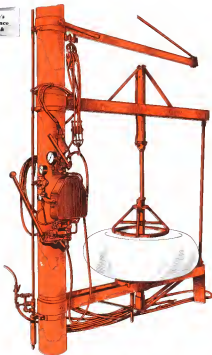
The control strip was designed by the TWA maintenance department to prevent aluminum control surfaces of DC-3 aircraft from warping when subjected to adverse gusts of wind on the ground. The important feature of this control strip is to eliminate any damage that might be encountered should the leading flap be lowered with

the control lever extended. Note that the lower attached portion of the strip is cut away to provide lowering of the flap without damage. The attaching clip that engages the leading edge of the wing when the lever is extended is mounted in the trailing end section so that a corner that the clip will be released allowing the lever to be pulled off automatically should the engine be moved before the lever is torn off by ground personnel.



### Heavy Duty Jack

The jack, built by the American maintenance engineers was designed especially for use with the Boeing B-27 Strakeless. The stands can be lifted by moving the two handles one at either side and the load raised directly to the ground through the pins at the bottom of the hydraulic column. The exceptionally wide base eliminated the need for slings to steady the plane while being raised on the jack.



#### Mechanical Tire Iron

To overcome the problem—and a big one it was—of separating tires from steel flanges for large aircraft, the TNA maintenance department designed and built this tire mounting and dismounting jig and assembly which has been used for both DC-6 and DC-8 planes. It separates the tire wheel and axle by means of the end of the axle

with the block and tackle used at leftward—the complete assembly is installed in the dismounting rack. The actual separation of tire and flange is accomplished by hydraulic pressure built up by the hand pump shown attached to the main column at leftwardish gives the power necessary to get the head over the flange



#### Engine Mount Alignment Jig

Production has thousands of production cars in production with this engine mount alignment jig which was set up by Eastern Air Lines maintenance department. The angled vertical column, of heavy tubular material, is bolted to the heavy metal base which, for added rigidity, is mounted on steel blocks. The ring aligning plate at top is also of heavy metal to ensure accuracy.

#### Test Stand Simulates Flight Conditions

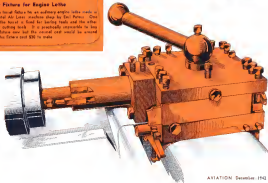
Designed and developed by United Air Lines, this test stand permits accurate checking of tire indicators under simulated flight conditions. A needle holding the indicators is turned by a synchronous motor at the rate of 180 deg. per min.—which is standard rate of turn. A torque clutch is provided for simultaneous in-clamping instrument for ground operation. The device is connected to a computer by means of which it is possible to check the various wheel speeds for lightness.





#### Turret Fixture for Regias Lettow

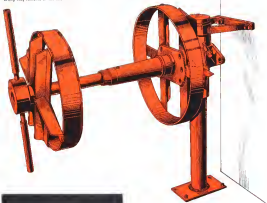
A turret fixture for an ordinary engine valve made at Continental Air Lines machine shop by Earl Peters. One side of the fixture is fixed for setting heads and the other side for cutting locks. It is probably impossible to buy such a fixture now but the second side could be added later. The fixture cost \$20 to make.



AVIATION December 1942

#### Tire Removing Fixture of Continental Air Lines

The wheel nut for one mounted on the shaft with the lines as it goes. By tightening the nut pressure is exerted on both beads by the nut closing the flanges on each side of the wheel. Tightening the nut will cause the bead to drop in the center of the wheel (both being very centered of the tire).

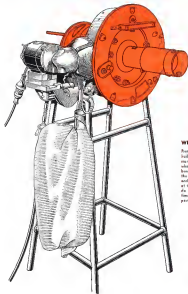


#### Tapered Ball Socket Remover

Aviation hydraulic fixture devised at Continental Air Lines for removing tapered ball sockets. By pressing one plunger down the oil forces the ball socket out of the taper.

### For Better Braking

This machine, assembled from a wide variety of "salvage" parts—including a household vacuum cleaner—was designed by the TWA maintenance department for sanding brake drum surfaces so they will be perfectly round after assembly as a unit. Thus, when the brake assembly is fitted to the ground brake drum, complete alignment may be obtained and the proper clearance adjustments made with little difficulty. Shop cleanliness is enhanced by use of the vacuum cleaner collecting shavings below the sanding wheel.



### Wheel Bearing Greaser

Prior to installation of this machine, designed and built in the TWA maintenance department, a minimum of 60 men were required to properly work wheel bearing greases in correct order of the bearing race. The bearing is held in place under the horizontal handle arm at top of the machine and compressed air, forced on by the handle arm at top right, forces the grease into the bearing to do a more thorough job at considerable saving of time. The machine uses both largely of "salvage" parts.



### Fuel and Bank Test Stand

A variable speed motor turning 1,000 rpm, geared down 1:10, driving a horizontal oil transfer band, transfers the test oil to the fuel stand. On the transfer band, the oil is regulated by the meter and the fuel and bank indicator. The transfer band is brought through the base of the fuel stand and around up to the transfer band which distributes evenly to the transfer throughout a 360 deg. arc. The use of this machine allows the fuel to be tested at 360 deg. arc. The TWA test stand with 3 deg. per second rate of turn of fuel is necessary to check the instrument on the stand is to get the reaction on the fuel instrument to 2 to 100 and operate either to left or right turn and indicate the instrument reaction will detect any needle with indication is obtained.

# Save Critical Metals

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G			3.50
H			3.50
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# MANUFACTURING

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PRODUCTION • DESIGN •  
RESEARCH • ENGINEERING

## DESIGN CONSIDERATIONS FOR PLYWOOD STRUCTURES... II

The second in a series of articles containing fundamental information on plywood airplane design discusses limitations imposed by fabrication processes and explores new basic design features made possible by use of plywood as an aircraft material.

By L. J. MARHOEFER, Chief Engineer, Ford Research Corporation.

A CLEAR UNDERSTANDING of the molding process is essential if a proper and economic design is to be offered. Proper consideration must be given to the construction of the article, its molding and subsequent removal from the form. In effect the consideration is really only another step in the list of considerations required of any design.

Due to the large number of articles published recently on fluid pressure molding, a brief summary of the subject seems almost superfluous. Fluid pressure is essentially a clamping device using the *deflative* feature of applying equal pressure perpendicular to the surface of any confined body. This pressure is harnessed to perform useful work by establishing a fluid tight form or containing shape on one side of the men, check and a fluid tight membrane on the other. If the fluid is enclosed in a pressure resistant shell and the pressure maintained, the membrane and fluid tight form will be forced together and once the men, check is strongly trapped by tension the two will not be displaced around the form. (Fig. 1-4)

Setting of the leading symbol is none of least, again in almost all requests is an obvious step. The result is a point closely conforming to the shape of the form and completely bonded. The designer's real concern is that the pose be of simple non-ambiguous and reasonable from the form after it has been worked. Thoughts is an ideal of any modernism and requires no general discussion. Beyond from the form is more widely understood if a point is considered to be similar to a resting face which is more likely to be considered.

**Abdullahi, Prince Datta**

The requirement of no "back-draft," usually considered in casting design, is ignored with somewhat colored (a)

ence. Good artists after melting have sufficient flexibility to permit "springing" them open to an appreciable degree and then sliding them in the form. The amount of spring varies with the size piece and casting; members molded into 2 Examples of the amount of "spring" are shown in Figs 2 and 3. Fig. 2 is representative of a two-piece commercial fastener in which a 1-in. strip was molded in a "bedding" position. No great difficulty was experienced in opening this fastener up from the bottom and top sufficiently to free the 1-in. strip and lift the piece from the form. For 3 is a wing shell in which a 3-in. lock was freed by "springing" the piece and sliding the form out of the turbine slot.

No precise rules may be laid down for the amount of spacing with the insertion of completed stress columns based on required deflection in the shell when spread the required amount. Each competition would obviously be tedious and manual practice has been to rely on judgement and trial.

Collapsable devices are only a partial answer to this problem. They have been constructed for many papers and used successfully. The principal drawbacks are the added expense in the original tool cost and the difficulty of replacement with sufficient accuracy in production. Thus, not a suitable only in extreme cases since most articles can be adjusted in place removal of the frame.

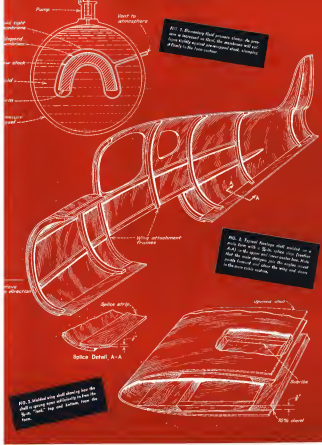
The choice between male and female mold release primarily to economic factors involved in the cost and difficulty of finishing the finished article balanced against the cost of installing the sufficient weather after making. The obvious points favoring a confound structure constructed on a male mold are the elimination of the highly skilled posing operations required to finish different

well known after making well the same note that the "bonded-in" reinforcing is properly loaded regardless of the skill of the fabricator. The inherent weakness of the bond between the steel and reinforcing members is not clearly appreciated by many designers due, primarily, to their lack of familiarity with the resulting product and the skill required to obtain an equal "bond-in" bond.

### Fundamental Basics for Integral Reinforcing

[illegible]

The final pressure welding operation involved with heat contains all the necessary elements required to achieve the fundamental interface contact between the surfaces to be joined. Most of us are familiar with the fact that sand when heated may be formed into shapes not possible when dry, and







# Design and Installation Factors For Aircraft Hydraulic Accumulator Systems

Various types are analyzed in relation to ease and speed of maintenance, a consideration which must be included in both construction and location

By EDWARD M. GREER,\* *Aircraft Hydraulic Engineer*

ALTHOUGH A NEWCOMER in aircraft applications, hydraulic accumulators have been used extensively in stationary hydraulic systems from almost the earliest days of hydraulic actuation. Due to the increasing use of hydraulic equipment in contemporary military aircraft, hydraulic accumulators have been developed to meet the increasing need for an emergency source of fluid power and to speed hydraulic action.

Specifically, an accumulator is a fluid pressure storage chamber and can be filled in a storage battery or electric circuit. It is a means of storing energy to be called upon as a source of power when the regular means of creating the necessary power, such as the generator in the electrical system and the pumps in the hydraulic system, are rendered inoperative or lack the capacity to do a particular job when called upon. In other cases the potential energy stored in the fluid can be called on automatically to operate the critical element required.

The size of the accumulator depends upon the amount of stored fluid necessary to meet specific requirements set up by the design of the particular airplane in which the accumulator is employed. This is governed by any one or all of four elements as follows:

- 1 **Pressure regulation**—In hydraulic systems which require constant displacement pumps, a pressure regulating valve is used to regulate the system pressure at a predetermined operating pressure of the particular hydraulic system. In most designs, to obtain this pressure is set at 1,000 psi and the regulator is set so that at this pressure the volume of oil displaced by the pump is increased into the system by leakage in the accumulator or, in pressure, while the operating pressure is maintained in the system beyond the regulator. This is called "back-leaking." When the pressure in the system drops due to leakage or attraction of one of the units and creates a predetermined pressure (in this case 500 psi), the regulator valve automatically closes the bypass into the reservoir and feeds the flow into the system until the 1,000 psi pressure level is again reached. This is called "backing." It may be of interest to state here that although current systems are operating at pressures between 1,000 and 2,000 psi, the majority of new designs are operating between 1,500 and 1,750 psi.

Due to internal leakage at the accumulator or regulator valve, plus internal leakage in the valves and actuating systems, the regulator valve tends to "bleed" in air when it is subjected to the opportunity to allow when it is under the low pressure condition. This bleed air can be up to 100 psi and to check for air for minutes in this system.

load and released very rapidly. In some cases it operates as frequently as every second. This results in shocks and vibrations which could tear loose from their fittings and do great damage in the system.

To compensate for this leakage, an accumulator is incorporated in the system as near to the pressure part of the regulator valve as possible, and of sufficient capacity to make out the two loading periods of the regulator is at least 1/2 sec and absorb any leakage that might come in the minimum action of the valve. In general, the standard and normal aircraft accumulator size of 40 cu in. is more than sufficient to do this work.

2 **Accumulator to pump**—In most military applications, situation, such as landing gear extension, dive flap operation or gun charging must be completed in a minimum of time. It may be beyond the capacity of the pump to supply a sufficient quantity of fluid under pressure to the actuating cylinder to do the job in the time limit allowed. Here the system accumulator is called upon to supply the extra push required. Depending upon the size of the airplane and the services which the hydraulic system is required to fill, either the 225- or 550-cu in. accumulator may be used in place of the flow is not discussed in connection with accumulators.

3 **Emergency operation of hydraulic system**—It is conceivable in military applications that the main source of hydraulic power supply, the pump, may be rendered inoperative either by engine failure or failure of the pump itself. It is therefore, required in a critical emergency aircraft that the system accumulator be of sufficient capacity to immediately operate the landing gear and flaps at least once, and to operate the power brake a sufficient number of times, to insure a safe landing.

4 **Secondary hydraulic system**—Many of our larger bombers and heavily armed aircraft employ secondary, complete hydraulic systems operated by their own pumping units independent of the airplane powerplant. The most common application of this type is the auxiliary gun turret. In this case an accumulator is placed in the system to aid the speed of turret operation. A very recent application of the same type has been the use of an accumulator in the hydraulic system of the hydraulic engine propeller. This was found necessary because the greatest need for hydraulic power is during the period of the propeller stroke when the engine was turning slowly. Consequently the hydraulic engine control can maintain a constant quantity of fluid to meet the time requirements for actuation.

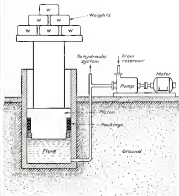


Fig. 1. Gravity type accumulator

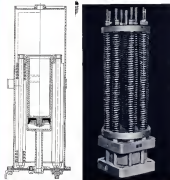


Fig. 2. Spring loaded accumulator (Air Accumulator Co.)



Fig. 3. Indirectly spring loaded accumulator

## Development of the Accumulator

In order to appreciate and understand the applications of any product, some knowledge of its background and development is necessary. The oldest form of accumulator, known as the gravity type accumulator, is still used in stationary industrial applications today. This accumulator consists of nothing more than a closed filled piston mounted vertically in a ground cylinder. There is a platform on top of the piston so that heavy weights are placed to correspond with the pressure required as the fluid is pumped into the underside of the piston (See Fig. 1). The greatest advantage of this type accumulator is that gravity does the work and that the pressure is constant regardless of the quantity of fluid in the fluid chamber of the accumulator. This latter is a characteristic not found in any other type.

Although perfectly acceptable in stationary plants, it can hardly be seen that for mobile applications this type accumulator would not be practical. In order to accumulate sufficient fluid under pressure such a device would be too heavy and cumbersome for use. Consequently, the use of a diaphragm, bellows, membrane and coil eventually is afforded a spring loaded accumulator was developed which is still in use. As shown in Figs. 2 and 3, the spring loaded accumulator consists essentially of a piston slowly filled in a ground cylinder. A disk is mounted on the piston and a series of pre-loaded springs is attached to this disk in such a manner that as the piston rises the springs are further loaded. As in the previous type accumulator described above, a fluid chamber above the piston connects to the pump and hydraulic system.

The great disadvantage of this type accumulator is that a very small quantity of fluid can be stored to be called on to do useful work. In many cases this is as little as a few cubic inches. Therefore, to meet applications the spring-loaded accumulator is most useful in protecting the periods between utilization in the pressure cycle.

As the size and speed of aircraft advanced, the demands on hydraulic systems progressed to a point where large volumes were required from hydraulic accumulators. In order to meet these requirements the larger volumes of accumulated fluid with dynamic pressure, the so-called accumulator was developed. The Douglas Aircraft Company, long a leader in the development of hydraulic systems in the aircraft industry, developed its fluid-actuated accumulator for the B-27. This accumulator is still in general use in all our newer commercial airplanes. The Douglas accumulator shown in Fig. 4 is of the piston type, gathered in design from the typical accumulator cylinder as used in hydraulic applications. This accumulator consists essentially of a piston fitted closely to a ground and lapped cylinder. A piston and nut are in the piston which extends through the lower head of the assembly and a sealed tank linkage by means of a V-type packing lies in this hole. The cylinder is closed on the upper end by a cylinder head which serves into the cylinder with appropriate seals to prevent leakage. A steel shaft type air valve is mounted over the top of the cylinder through which a port hole charge of air or nitrogen gas can be introduced. An oil port at the bottom of the cylinder allows oil to be pumped into the lower chamber. The piston shaft acts as a separator between the air and oil chambers and contains outside glands to prevent leakage at various. The piston nut extends outside the cylinder so that it acts as an indicator as to the quantity of oil accumulated in the unit.

Although this type accumulator represented a great step in hydraulic design, it was quite troublesome from a water and maintenance standpoint. The packages determined and labeled and have been from the beginning a source of constant trouble. It was as a result of the experience gained in this accumulator that the spherical diaphragm type accumulator developed.

However, research in the Floating Point Accumulator is a great design the same as the most discussed above, and since this accumulator is in use in many aircraft today, special attention must be given it here. As we saw previously in Fig. 5, the device consists essentially of a piston containing the newly de-

veloped "O" ring packing, slowly filled to a desired cylinder which is closed off on each end with suitable cylinder heads which in turn provide passages to permit removal liquids. One cylinder head contains a shock absorber type valve, the other contains the oil intake port.

The Floating Point Accumulator is fundamentally used in design and is a result of the development of the seal ring packing technique it gives satisfactory service from a maintenance standpoint. The greatest disadvantage of this unit is its maintenance as required over the diaphragm type accumulator. Also, as we saw the rate of maintenance is higher than that of the diaphragm unit.

The most popular type of accumulator used in aircraft hydraulic systems today is the spherical diaphragm type. This

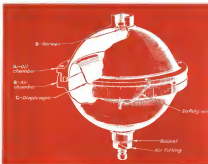


Fig. 4. Spherical accumulator (Douglas Aircraft Co.).

linear consists essentially of two thin hemispheres, joined together to form the housing. A suitable rubber diaphragm, mounted at a divide between the two hemispheres, separates the accumulator into two chambers—one for air, one for oil. A hole at the pole of each hemisphere contains either the air intake valve or the oil port.

Douglas Aircraft, Inc., supplies the diaphragm unit with the most widely used of these spherical accumulators. These units, shown in Fig. 5, consist of two hemispherical end-bells secured together, and it contains a synthetic rubber diaphragm which separates the hemispheres. Generally speaking, the Vickers unit is identical with the Douglas accumulator.

The exception is that the Vickers unit is made of chrome molybdenum forgings secured together as compared to the lapped steel housings of the Douglas product. However, the Vickers accumulator has definite advantages in weight saving and ease of maintenance.

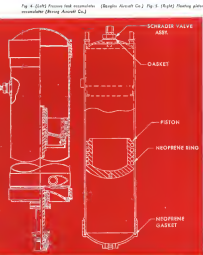
The Schematics Accumulator, Inc., built type accumulator is the latest design to enter the field. This accumulator was designed primarily to meet the high production costs brought about by the war. Special emphasis is given to a simple design, ease of maintenance, and low cost. As illustrated in Fig. 6, the Schematics Accumulator is of the air-actuated bladder type consisting primarily of a steel shell or

housing, a fully enclosed synthetic rubber bladder, welded to a high pressure (monomeric fire type) air valve, a steel plug containing a number of check holes on one end, a closure nut and a rubber rubber packing. The housing is of non-porous construction (resistant to air) as a closed joint) made from steel sheet drawn into a cup and then spun into a ball. The bladder, the first and only fully enclosed synthetic rubber unit of this type made in this country, is specifically designed to give high volumetric efficiency and long life.

## Principles of Operation Air Loaded Accumulators

Basically, an aircraft hydraulic system utilizes one of the air-loaded type, the principle of operation of this type unit will be discussed here. Three principles must be met in the design and analysis of this type unit: the floating piston type.

In operation, air is pumped into the air chamber through the air valve as the gas bed pressure is required. Then oil is pumped into the oil chamber through the oil port. The first drop of oil which enters the accumulator must displace the equal volume of air above the piston or diaphragm. Therefore, at least once in the pressure package into the air chamber. As the oil is pumped further into the accumulator the piston or diaphragm rises.



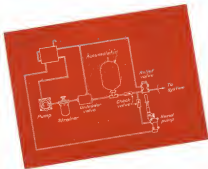


Fig. 8. Schematic diagram hydraulic accumulator.

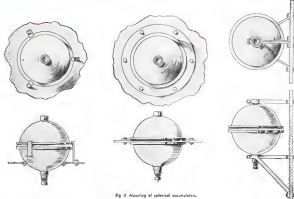


Fig. 9. Mounting of spherical accumulators.

tion compressing the air in the chamber above it so that at all times equal pressure exists between the air and oil. This pressure is transmitted throughout the hydraulic system, which is connected to the pressure side of the accumulator.

Inasmuch as oil is incompressible, the air or nitrogen under pressure acts as a dynamic force in the main body as a spring to maintain the pressure in the accumulator and to force it out under pressure to do work on the hydraulic system. It should be noted here that as the fluid is discharged from the unit, the air expands and the pressure drops. For this reason the pre-load or initial air charge plus the volume of the accumulator must be sufficient to do the work required from the accumulator.

For use in aircraft the "pre-charge" or initial air pressure charge has been arbitrarily set at one-half the working pressure, and volume of air remains fixed, unrelated to that of the lowest pressure of the fluid complete activation has taken place. It is not accurate that the pressure drops as the oil flows from the accumulator into the working unit since it is near the end of the stroke of the actuating cylinder that the most pressure is needed in the majority of installations. This results in the use of accumulators which are rated large

Fig. 10 and 10a. Bell-type accumulators mounting method.

in capacity had are not used precisely to the full capacity of their chamber. In cases where the full capacity of the accumulator is used, the actuating cylinder diameter is large enough so that at pre-load pressure a complete stroke against the reacting load can be accomplished.

Fortunately in operation the compression and expansion of air in the accumulator is slow enough so that the heat developed can be dissipated in the installation of volume requirements. Therefore, Boyle's law for gases,  $P_1 V_1 = P_2 V_2$ , can be applied to determine the air volume requirement. This air volume indicated from the total volume will give the accumulated oil volume. For example:

If we have an operating pressure of 1,500 psi and choose a pre-load of 750 psi, with a total volume of 225 cu in between 1,500 and 750 psi for complete operation of the hydraulic system. What size accumulator is needed?

We know the air pressure and volume vary as  $P_1 V_1 = P_2 V_2$ .

$P_1 =$  Pre-charge pressure = 750 psi

$V_1 =$  Total volume of accumulator at pre-load (Accumulator is completely full of air)

$P_2 =$  Operating pressure = 1,500 psi

$V_2 =$  Air volume at 1,500 psi —  $V_2 = 225$  cu in.

because we require 225 cu in. of oil at the end of the accumulator being air

$1,500 P_1 = 1,500 V_1 = 225$

$800 P_1 = 337,500$

$P_1 = 625$

Choose nearest commercial size which is 525 cu in. and redesign the accumulator to a higher level keeping pre-load pressure as in

To determine pressure available after 225 cu in. of oil has been exhausted from the accumulator, proceed as follows:

$P_1 V_1 = P_2 V_2$

$750 \times 525 = 1,500 V_2$

$V_2 = 262.5$  cu in. air

Volume oil =  $525 - 262.5 = 262.5$  cu in.

after exhausting 225 cu in.

Volume oil =  $262.5 - 225 = 37.5$  cu in.

Pressure available with 37.5 cu in. oil accumulated

$750 \times 525 = P_2 (525 - 37.5)$

$300,000 \div 487.5 =$

$P_2 = 775$  psi.

The system can be designed for a maximum operating pressure of 775 psi.

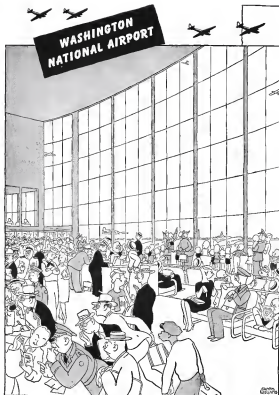
**Installation of Accumulator**

In order to save weight in oil and tubing it is best to install the accumulator as close to the hydraulic pump as possible. Route the pump as practically as possible in the region, it has been found in most applications, the best location is in the middle section properly on the firewall directly behind the engine. Also, in this location the heat of the engine aids the operation of the hydraulic system in keeping the accumulator warm in sub-zero flight conditions. In addition, there is the added advantage of limited vulnerability to greater moment or failure would have to pass the engine to get to the accumulator in frontal attack or

go through the armor-plated "pilot" compartment to rear section. For most efficient operation of the accumulator valve, the length of tubing between it and the accumulator should be as short as possible.

A typical installation showing the proper wiring in schematic diagram is shown in Fig. 8. In this figure it can be seen that the accumulator is placed between the accumulator valve and the relief valve. For size in handling and servicing the accumulator can be mounted on a panel with the accumulator valve and streamer. This panel assembly forms a unit which can be mounted on the airplane and removed as a unit for servicing.

Based on a recent series of tests made with a transparent basic accumulator, it is the opinion of the writer that wherever possible the hydraulic accumulator should be installed in a vertical position with the air chamber above the oil. When the accumulator is mounted with the air chamber above the oil, the forces set up by the buoyancy of the air and its attempt to rise above the oil set up severe strains in the diaphragm and generally distort it. This sets the life of the separator a great deal. On the other hand with the air above the oil, the action of the separator is smooth and takes its normal, designed shape in the accumulator. Aside from this it is generally easier to put in the air valve for gas-blowing when it is on the top end of the accumulator. It has been found in these tests that almost 100 percent efficiency can be obtained with the air above the oil, and any air that may enter the accumulator from (Turn to page 111)



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← Elements shown The New York Museum



# FABRICATING DROP HAMMER DIES

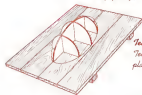
Some new ideas applied to an old technique facilitate handling and efficient utilization of drop hammer dies.

By CHRIS J. FREY,  
Beverly Aeronautical Corp., and

STANLEY S. KOGUT,  
Eastern Aircraft Production Plant

Although the present article describes graphically the standard procedure in the fabrication of dies, several innovations are explained which speed production materially.

These are the clamping lugs, cast integrally with the dies, removable dowels which provide convenient attachments for handling and removable studs which simplify storage.

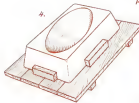


1. **Template skeleton**  
Template skeleton of part to be made is placed on a board. Plywood may be used

**Plaster model (in form).**  
Plaster is packed in around the template to form the model which is then surrounded by a box whose size can be adjusted by means of angle irons and clamps. Sides of box should slant outward at an angle of about 3°. Clay, plaster or wood may be used for pattern.



2. **Plaster pattern section showing lifting bolts in place.**  
The frame is then filled with plaster into which a set of nuts and bolts are suspended by means of an angle iron. This is used to draw off the pattern



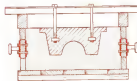
4. **Pattern on bottom board of flask showing blocks for clamping lugs.**

Bolts are screwed out but nuts are left in. Plaster pattern is laid on a board with pieces of wood around it. These will later form clamping lugs.



5. **Assembled flask—with sand. Note clamps in place.**

Flask is placed on bottom board surrounding the plaster pattern. It is packed with sand and covered with another board. The studs on the side of the flask are centered so as to provide an easy means for turning it over.



6. **Flask inverted—ready for removal of pattern.**  
The assembly is turned over and the board that was formerly on the bottom is removed. The angle iron is used to draw out the plaster pattern.

**Sand mold with pins to create lifting pin holes—gates ready for pouring.**  
Steel dowels coated with graphite are inserted into the sand at an angle. Pouring gates are cut and metal is poured.





8.

*Die in sand—showing cavitation that must be corrected.*

*Shrinkage generally takes place during cooling and more metal must be poured to obtain a flat bottom for the die.*

#### 9. Completed die ready for punch.

*After cooling the die is removed. The dowels can be easily removed from the die for reuse in other molds. Pins on sling are inserted into the holes for lifting. Note clamping lugs.*



10.

*Adjustable steel frame around die—ready for pouring. Ball spacing fixture in place.*



*An adjustable steel frame is placed around the die, fastened with wedges, over size removable studs and nuts suspended in it and the Lead Antimony punch is then cast into the die.*

*Studs can be removed for reuse—die storage is facilitated.*



#### 11. Completed

*punch and die.  
Standard studs  
in punch.*



#### 12. Manufactured part.



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On this page is an example of one of the ways oil hydraulics is helping out on tough jobs... a Denison Hydrolite test stand checking the hydraulic circuit of an attack plane. Powered by a gasoline engine, and used in the field—where electric power is not available—it checks aircraft hydraulic systems using extremely high operating pressures. An electric-motor driven unit, illustrated on the following page, performs even additional services. Check the many important tasks in aviation now being handled by . . . . .

*Hydrolite*

THE DENISON ENGINEERING COMPANY, COLUMBUS, OHIO



Denison electromotor-driven HydroOLac Test Stand for testing aircraft hydraulic systems using up to 3,000 pound pressure. Self-contained reservoir, transducer, and valve control provide for testing and adjusting individual units of the system. Test oil filter, with individual selector valves, are provided.



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HydroOLac Spark Plug Test Stand, for testing aircraft spark plugs in conjunction with an auxiliary aviation igniter system. Plugs are subjected to selected pressure and high voltage. Antenna control means voltage passing through the plug only when predetermined pressure is received, and while readings are made.



Magneto Test Stand, for testing airplane magnetos at speeds from 50 to 6,500 r.p.m. Tests can be made at room temperature or, under the heat, at various conditions of heat, humidity, and altitude. Corrosion, sparks, misfires, sparking, feathering, voltage consistency, and shunting resistance can be tested. Operating temperature of the stand can be controlled for making life tests. A similar portable magneto test stand, without altitude equipment, is available for maintenance service.

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You'll find Denison HydroOLacs producing war material in plants all over the country . . . presses assembling critical parts, valves and controls operating important equipment, and test units assuring safe operation. On these pages are right examples of the new help Denison oil hydraulics is giving just one industry — Aviation.

From these illustrations you'll see why HydroOLacs has become the Aviation Industry's "New Right Hand." The work of Denison engineers has opened a new range of applications for oil hydraulics, made it a better, faster, and more economical way of solving new problems and improving old methods.



Denison Aircraft Fuel Transfer Valve, used for manual selection of fuel flow from fuel tanks.



Hydraulic Populike Test Stand, for testing distributor valves and feathering action of HydroOLac Populike Valves installed in a special collar and pressure indicator. With these installed, tests can be made for feathering action, block angle, and feedback under high pressure.

Denison HydroOLac Packing Test unit, for testing aircraft hydraulic packings. Static pressure tests, and life tests at selected pressures, can be conducted with this unit. The emergency unit, at left, provides for packing tests under controlled temperature conditions ranging from subzero to 160° F.



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LEFT: Eric Doolittle of Buffalo played national chairman of National Aircraft Brotherhood Committee for year 1942-43 at Memorial Meeting in New York. He is in line Curtis Wright. Above: Doolittle. . . . RIGHT: Jack Casner Seattle, standard engineer for Boeing Aircraft Co., past national chairman of National Aircraft Standards Committee for 1947-48

## Aircraft Standards Committee Program Keyed to War Needs

Fourth annual meeting of the National Aircraft Standards Committee convened in New York, Nev., 9-13. Groundwork laid for setting up dimensional standards in aircraft new materials sizes.

By GLEN M. ARON, Jewish Eastern Nations Group, Inc.

Delegates representing major scientific disciplines participated from across the National Academy of Sciences. Committee members included: Harold Morley Ford, New M.D. Entomologist in April 3; J. Thompson (VetMed); A. W. Galt (Biophys); Charles Smith, Jr. was chosen as West Coast (VetMed); R. F. Wade (elemental West Coast (Sci. education)); Eric Snoddy, national chairman (Curtis Wright); W. O. Craig, A. L. Chambers and Gerald Blumstein; W. R. Colwell was chosen as East Coast (VetMed); Anthony J. E. W. Marks (Africa and national education) (Washington D. C.); and Ben Schiller (University of W. W. Medical, Washington D. C.). Also, Eric A. (Washington D. C.)

[illegible]



White is gray—and light makes tell the story! Reflective from white concrete floors, here at Consolidated's Southwest plant, proved to be 41 percent better than floor from reflecting white surfaces, and vertical illumination from the gray rapped gray by a good 20 percent.



## WHITE FLOORS

## LIGHT Those Under-Wing Shadows

By sending 61 percent more light beneath wings, 20 percent more on vertical faces, easily maintained white flooring makes seeing easier, quicker . . . reduces accidents, errors . . . "ups" quality and production. What's more, Consolidated sights a \$30,000 first-year saving in lamp fixtures, maintenance, and power.

By F. L. MABIE, *Manager, Atlas White Floors, General Atlas Cement Company*

**PROBLEM:** To find an efficient way to boost an adequate amount of light to the underside of wings and fuselages which lose much of the light from above, then ensuring undelaying and unerrant working places. Solution: Light-reflecting floors made with white cement.

But at that though walls and ceilings have long been recognized as great reflectors and diffusers of light, it is only in recent years that the use of floors for this purpose has been given its due—and decidedly deserved—consideration.

It was examination of military aircraft, which brought attention to the previously overlooked reflective values of European, Russian, Canadian, Douglas, and North American widely installed light-reflecting white cement floors in assembly plants in 1941—led them to recognize that they are now installing "more of the same" in new plants being completed.

"But," ask most people, "aren't white floors difficult to maintain?" Probably, experience shows they are not. According to technicians, white floor maintenance—frequent sweeping, occasional damp mopping, and periodic repainting—is neither more difficult nor more costly than the maintenance required in Consolidated's bookkeeping plant! "It's just as easy to keep our white cement floors clean as our gray cement floor. Further, white promotes cleanliness."

Standard routine calls for sweeping daily, damp mopping once a month, and repainting with a rotary broom once every two or three months.

Having shopped floors of gray cement and of white cement, separated only by an expansion joint and with identical lighting fixtures over the same, the Consolidated plant in question, designed and built by the Kasha Company, provided a pertinent basis for study and comparison of the benefits.

An extensive illumination survey (conducted in Electrical World, July 28, 1951) was made by the General Electric Co. over three reference days, and in addition the plant engineers made comparative studies when the floors were new and after they had been in use six months. And it was shown:

1. That the white cement floor reflected 61 percent more light than the gray—saved 61 percent more light on the underside of wings and fuselages.
2. That this higher reflective factor increased vertical foot-candle 20 percent.
3. That when lamps needed moved and floors and lighting fixtures were in dirty or day were exposed to grit, the white floor increased more of its reflecting value than the gray.

To obtain the same high vertical foot-candle over the gray cement as was effected with the white cement, it was calculated here increased cost for lamp fixtures, lamp maintenance, and electricity by 30 percent, or more than \$75,000. And that \$75,000 figure is more than \$30,000 above the item cost of the white floor.

What's more, there is an additional potential saving of some \$10,000 in its continuing expenses, for extra light fixtures would mean extra heat, requiring an additional air conditioning expenditure.

Worth of the better illumination contributed by white cement floors is far reaching. By making seeing easier and clearer, both quality and quantity of production are increased, while accidents are reduced, as well as errors and spoilage, and there is thus an added safeguard against stock shoppings.

Seeing that concrete may be used to ring old floors, it may be pointed out that the white product, a fine portland cement, offers the same dependability, strength, and uniformity as the standard

type, and the materials are readily available. Moreover, since floor surfacing must meet stresses and withstand heavy traffic, white concrete is certainly to be considered one less permanent choice material when the goal is clean, neat, and maximum light reflection. The notion of being "false deep" is the low-maintenance white concrete offers "built-in" strength and longevity.

When the illumination, production, and protection factors are important, the white floors may be considered not only in assembly plants and hangars but also in laboratories, offices, and numerous other buildings. In store walls, corridors, and the like, too.

Fundamentally, white walls are effective reflectors only within close range and white ceilings are often inefficient reflectors because of grime, oil-splashed surfaces, etc., thus floors which do have no lamp reflected as illumination provide many additional means to reflect and diffuse light where it is so much needed—close to the working plane. Each underside and vertical-face selection is particularly important in

assembly tasks where considerable work is undertaken wings and fuselages and on vertical surfaces.

Dark corners or shadows are either removed or diminished, and meanwhile a light background is offered against which movement machine parts may be delineated. By their very expense, light-reflecting floors contribute light throughout the broad working area, thus making seeing easier and clearer.

White floors provide a background with a degree of brightness more comparable to the materials worked on in the industry, thus they promote ease of seeing by reducing contrast between the working task and the surrounding background. Perhaps the most significant advantage the employer's attitude and workers his very white promoting cleanliness, cleanliness, safety, health, and morale. Consolidated employees prefer to work on the white flooring.

Production is potential landmark too. White floors may be sighted in the September, 1941, estimate that an additional \$6,000,000 sq ft of floor area will

(From page 303)

**BUILT:** But white floor makes the shop, where the vehicle is assembled, is offered in large plants down all divisions now at Lancaster in Consolidated assembly plant. With no prefer to 'used in the white.' Concrete floor makes shop complete-the-up visibility throughout working area. There is no grime.

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The SPAD-116 had low maintenance—needed no electric system.

This big transport plane will need hundreds of

## PRECISION ELECTRIC ACCESSORY MOTORS

### BODINE MOTORS ARE BUILT TO LAST



RESIST  
VIBRATION



ENDURE  
TEMPERATURE  
CHANGES



LIGHT  
IN WEIGHT

### MEET AIR CORPS SPECIFICATIONS



Whether they are used on death-defying warplanes or on the busy skyliners of a few years hence, aircraft accessory motors must meet the same requirements. They must be carefully designed to make them extremely light in weight. They must be thoroughly dependable, whether they are used continuously or intermittently. They must be safe for operation near gasoline fumes. They must withstand high temperatures. Continuous vibration must not affect them.

Bodine electric aircraft motors easily meet these requirements. High standards of precision are constantly maintained by accurate machining from tested high quality materials, and by constant testing and inspection of all parts during manufacture. While Bodine's present production is entirely devoted to making motors for the war effort, their 35 years of engineering experience are available to you in developing your designs for post-war use. Bodine Electric Company, 2274 W. Ohio St., Chicago, Ill.

# BODINE

FRACTIONAL HORSEPOWER MOTORS

THE MAINTENANCE MEN IN the factory, even before parts have been assembled to make the completed unit, whether it be an engine, propeller, airframe or accessory. Such care is particularly necessary in aircraft engine parts where highly polished parts can easily be damaged by improper handling.

Proper handling today is being increased by increasing use of the atom bomb, some of which have been found to be superior to synthetic materials which they replace. In the manufacture of Rolls-Royce Merlin XX aircraft engines, for example, Packard engineers have used such a catalyst as necessary for metal bakelite, impregnated and used in parts handling.

The bakelite, varying in size and type, are ordinary steel rod, with metal inserts. In the application for engine parts handling, the bakelite are first degreased and dipped twice in a Resistoflex PVA solution especially formulated for casting metal, then run through a low temperature oven to

## Synthetic Coatings Protect Engine Parts

New use of Resistoflex PVA solution at Packard puts resilient covering on wire baskets to maintain undamaged surfaces in degreasing and transportation.

speedy drying. The resulting coat has certain characteristics of rubber—flexibility, elasticity and resilience—but is not affected by gasoline, oil and most organic solvents including chlorinated hydrocarbons. It resists no vulcanization and contains no sulphur which might tarnish highly polished metals, an important factor in areas such as that at Packard.

The material which Packard has put to this new use on a large scale consists entirely of a modified polyvinyl alcohol compound which, when processed, is neither thermoplastic nor thermosetting. With proper handling it can be worked to any shape or extended into hose or other flexible products using pressure which are similar to those of the rubber and plastic industries.

**FIG. 1.** Preparing a wire parts-handling basket at the Packard plant producing Rolls-Royce "Merlin" engines. The basket is purchased second-hand and dipped twice in Resistoflex a modified polyvinyl alcohol solution and then run through a drying oven. The resulting coating is a tough elastomer and without making the basket so heavy, resistant so that it will not bend highly polished engine parts. **FIG. 2.** Almost any type or size of basket or tray can be coated with the synthetic. In the background at the left is a rack with special-type bak-

et and at the right a metal tray for larger engine parts, while the centers in the foreground have different types of basket inserts. The trays can be used both for holding parts during degreasing and for transportation. The synthetic rubber-like resin material used for wire mesh tray and bakelite inserts is protected by the solvent used in degreasing. **FIG. 3.** The Resistoflex coated containers are also used for storage. An added advantage lies in the fact that the parts can be easily identified, even on the bottom of the stack.



BUY  
WAR  
BONDS

# High Performance TRAINERS..



## Call for High Performance PUMPS!

ROMEC fuel pumps are used to the exclusion of other types on the Cessna "Cessna" twin-engine low-wing monoplane used for advanced training.



The pumps illustrated are but a few in the extensive line of ROMEC aircraft pumps for fuel, air, oil, and ethylene glycol. Pumps famous for their fine flight performance.

We pledge our enlisted cooperation in this all-out emergency to help you attain the correct answer to every pump problem. Simply write us full details.

As the name cannot perform better than that itself, so the pump and valve cannot perform better than that pump.



# Romec

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Manufacturers of DIESEL OIL PUMPS, ELECTRIC MOTOR OIL PUMPS, and HAND OPERATED FUEL PUMPS

AND 1. Blisters and end of the material handling process. The area reflects not just the nature of the material but also the nature of the material. Also shown in the above process is the fact that these parts are changed before grinding. This is important in the grinding process since removal time quickly... FOR 1. The process in which aluminum splinter heads and blocks are given finished stress relief treatment as they are moved through a slowly moving conveyor. Special selected steel for heat and heat is shown at left.

WHILE HEAT-TREATING is often made of a "one-stop job" large scale manufacturing of Rolls-Royce aircraft on glass for both British and American planes has brought the production line technique to the Department of Production Motor Car Company's plant. Volume of heat-treated work is such that the department occupies a separate building adjacent to that in which the heat-treated parts are assembled.

The unit is equipped to do everything, including grinding, turning, drilling, and inspection of steel parts, as well as to perform stress relief on some aluminum and steel parts. All work is done on the ground level floor, although some of the equipment sets on foundations located in the basement, which also contains loading docks and piping.

Parts to be heat-treated are received on trucks, some of which are designed to carry parts for particular parts. Although most of the parts are already partly machined, great care is exercised to avoid warping or warping which might lead to rejection or even to serious failure. Most parts undergo grinding or other machine work after heat-treatment but are, nevertheless, handled much as if they were in finished form and ready for assembly.

Most of the parts are first delivered to the carburizing and hardening end of the heat-treated department, where there is a carburizing tank whose all parts to be heat-treated are removed. Many parts, chiefly forgings made from AMS 6250 and 6250 alloys (equivalent to SAE 5142 and 4142 respectively), require carburizing which is done in hot Leeds and Northrup furnaces arranged in two rows of five each. Parts to be carburized are placed in wire trays and baskets for loading into automatically controlled furnaces by means of a car-like bridge crane equipped with four controls.

Carburizing is done at 1,700 deg. F for one to eight hours, depending on the thickness of case required. About 6,000 sq. ft. of surface are ground in eight hours. Curves, supplied by external gas containing about 15 percent cyanide, is



## Heat-Treating Aircraft Engine Parts

Application of production line technique to custom jobs illustrated at Packard plant producing Rolls-Royce engines.

continuously controlled by a fan in the bottom of each furnace. Flow of the gas is regulated as required for the carburizing process and remains in from 5 to 20 in. per hr. Subsequent to the carburizing parts are, in many cases, transferred to an oil-quench tank which is where they remain in a natural gas atmosphere at a temperature of 700 deg. F for two to six hours. Parts which are not to be hardened at once, and which are returned to the carburizing department for removal of the case where it is not wanted, are allowed to cool slowly to 1,300-1,500 deg. F, and the

baskets are set on the floor for cooling to room temperature. Parts carburized range from 1/2 in. plugs up to pairs of 12-in. diameter.

Most of the parts to be hardened, whether previously carburized or not, are put through one of two Holden continuous furnaces, which are heated by natural indirect tubes using gas fuel, hence the products of combustion do not come into contact with the parts undergoing heat-treatment. The furnaces are divided into five zones, each equipped with its own temperature controlling device. The atmosphere of both furnaces



# Wittek AVIATION Hose Clamps

For Dependable Hose Connections

Striking through the skies, squadrons of swift fighter planes are in the fight and doing our nation proud—establishing brilliant records as a duty routine of our Army Pilots. Wittek Aviation Hose Clamps are helping to keep many of them living with dependable hose connections.

Since the early days of modern aviation Wittek has served the industry and today this reputation is serving the Nation well. Wittek Aviation Hose Clamps are made of quality materials and by experienced craftsmen. They are used by the outstanding leaders of military aircraft and most existing Army and Navy specifications. Wittek Manufacturing Co., 4335-15 West 24th Place, Chicago.

**WITTEK** *Aviation*  
HOSE CLAMPS

## REVIEW OF PATENTS

By A. HARRY CROWELL, Patent Lawyer

THE FOLLOWING are reports of the more significant recent patents in aviation developments announced by the U. S. Patent Office. Mr. Crowell will be glad to furnish Aviation readers with preliminary information without divulging important data patent and trademark matters. Address inquiries to Aviation, 126 W. 42nd St., New York, N. Y. Complete printed copies of any of the patents listed are obtainable at a cost of 10¢ each directly from the U. S. Patent Office at Washington.

**Air Brake, 2,597,373, C. W. Todd,** assignor to Aeroquip Company of America. The invention relates to the balancing of rotors of unbalanced force having an asymmetry of mechanical drag. It is especially applicable to the balancing of non-rotational single blade rotors of the propeller governor type commonly used in aircraft.

**Roller Locking Control System, 2,591,493, G. H. Winterhouse and G. L. Davis,** assignors to Washington Institute of Technology, Inc. A plurality of fixed stations are disposed about a landing area. Mobile transmitting means are used in the establishment of the radiating fields of the landing system. The stations of the mobile means and the fixed stations is such that the transmitting means may be properly positioned with respect to any desired or necessary direction of landing.

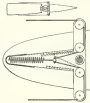
**Rate of Shock Detector, 2,597,475, E. O'Connor,** assignor to Bendix Aviation Corporation. A pressure rate type of instrument, wherein a differential between the pressure change and rate of the instrument, established by a change of one of the pressures is related to rate into the rate of shock as desired, previously adapted for use in aircraft aircraft.

**Annular Control, 2,599,762, H. H. Webster,** assignor to Bendix Aviation Corporation. An appliance to start the wheels rotating prior to landing so that their speed is nearly proportional to the landing speed of the plane. The device also provides for gradual deceleration of the wheels, after first contact with the ground. The object is to save wear on the tires.

**Transmission, 2,616,565, E. G. Jackson, Jr.,** assignor to Wright Aeronautical Corporation. A sliding system by which the drive ratio in a gear train may be altered while the gear train is under load, particularly for trussed upgearbox design as used in aircraft engines.

**Induction System, 2,616,648, W. O. Owen,** assignor to Wright Aeronautical Corporation. A pressure control system in a turbo load turbocharging system by which induction pressure may be maintained at that end of the system most remote from the pump while disposing the inlet valve right close to the pump.

**Variable Compressing Device, 2,599,811, H. H. Brundage,** assignor to Douglas Aircraft Company, Inc. The device is for compressing fluids in a pump, especially for



controlling several systems of aircraft. The device functions only while the turbine is the valve is required or as of the most order of magnitude, and which is valve actuating system, or locked out, on operation of the control system.

**Braking Machine, 2,598,542, P. F. Tuck,** assignor to Curtiss-Wright Corporation.

Use a machine tool of the pressurizing branch type, particularly a propeller blade pressurizing machine which utilizes the principle of increasing and which is capable of taking out a propeller blade to last from quickly and accurately.

**Collective Landing Gear and Arrestor Gun Recoil Mechanism, 2,599,227, C. C. Davis,** The gun subject to firing when is activated about carriage or mount are engaged with the landing gear in a recoil position, the standard recoil device of the gun mounting being thereby disarmed.

**Shock Absorbing Strut for Airplane, 2,599,228, H. W. Cleveland and E. S. Warner,** assignors to the Cleveland Promotional Tool Company. A strut or bell shock absorber including an oil shock strut including two cushioning action during ground contact and having automatic correct landing position obtaining means when off the ground.

**Valve Assembly, 2,599,243, G. T. Dorney,** assignor to Aeroquip Manufacturing Co., Inc. An improved valve assembly and valve means so that a valve of this type may be used for regulating the flow of fluid in an engine. The valve structure may be readily removed without complete disassembly of the valve assembly.

**Propeller Control Mechanism, 2,599,253, C. J. McNeill and H. T. Swank,** assignors to Bendix Aviation Corporation. An improvement on the Caldwell patent 1,985, 819 type, adding to the Caldwell system the concept of automatic pressure adjustment. A propeller push control mechanism involving a hydraulic unit and control valve.

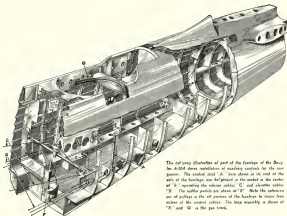


## USE STANDARD ADICTION

Typical parts being distributed to members by National Aircraft Standards Committee in its efforts with them for adoption of standard standards. It is the committee's hope that they will not only promote standardization among aircraft manufacturers but will encourage individuals in various fields to select similar standards for distribution throughout the industry. [See article page 161]



The retractable tail wheel of the Republic A-10 "Granger" is shown at right. Operated by a hydraulic motor (shown) and shown the end, the wheel swings back out and up into the fuselage, pivoting at "A." "B" is the axle of the gear. "C" is the lower tube. "D" is the shock strut and "E" is the foot. As the wheel retracts, the roller "F" drops over the angle "G" and the spring "H" pulls the housing "I" into place behind the wheel. "J" is the steering rod connector for the wheel and "K" is tail wheel control link and gear operating mechanism.



The cutaway illustration at part of the fuselage of the Douglas A-26 shows distribution of hydraulic controls for the main gear. The control disk "A," here shown in its end of the side of the fuselage, can be placed in the center in the center at "B," operating the wheel under "C" and shutoff valve "D." The upper patch are shown at "E." Note the reference are of pulleys in the side portion of the fuselage to insure free motion of the control cables. The trap assembly is shown at "F," and "G" is the gear track.

# Making the Enemy DIE

FOR HIS COUNTRY

## VICKERS HYDROMOTIVE CONTROLS

Soldiers of the U. S. Army are now given this axiom: "It is commonly supposed that the primary duty of a soldier is to die for his country. This is not true. It is his duty to make the enemy die for him."

The spirit of aggressiveness which this axiom should be instilling in every American, and all Americans will want to do everything they can to make the enemy "die for his country" in this war of survival.

Vickers Incorporated is contributing to this effort on many fronts. Vickers Hydromotive Controls on our war planes have helped compel enemy air forces into this sort of heroism. These high pressure and hydraulic controls are dependable, accurate, easy to operate, easily adjusted, measure to vibration and shock... reliable no matter how tough the going.

**VICKERS Incorporated**  
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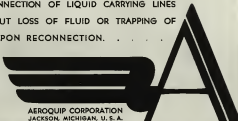
Engineers and Builders of  
all Hydraulic Equipment  
Since 1921



AEROQUIP SELF-SEALING COUPLINGS ALLOW  
DISCONNECTION OF LIQUID CARRYING LINES  
WITHOUT LOSS OF FLUID OR TRAPPING OF  
AIR UPON RECONNECTION.

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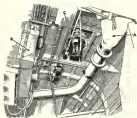


AEROQUIP HOSE LINES



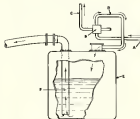
Wing roots of the Junkers JU-52 are located outward of the center engine frame being close to a tube with capacity of 150 gal. per wing. The tanks are built in place by access doors. 'A' - Metal access plates (removed for the drawing) are secured onto the lower surface of the wing. The landing gear legs pivot on 'B' and 'C', and 'D' is the retracting shock. Fuel pumps are located inside the vicinity of 'B'. The venturi 'F', an aluminum tube with removable cover, contains all electric wiring for the wing. Hydraulic and fuel lines enter the wing at 'G'. The leading edge of the wing is located for drawing the inter-converted venturi 'H' being

part of the heated air to the cabin. The venturi blind fitting hose 'L' shows an extended position, is operated by manually by the seat 'J'.

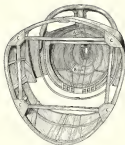


Leading edge vents the fuelage, the fuel following pipe 'A' is supported from the root, entering to the opposite side behind the seat 'J'. The directional line is in the center of 'G'.

As shown in the diagrammatic drawing below, the Junkers JU-52A-1 has a unique fueling system for the 300 gal. fuelage tank. An auxiliary placed in the tank has for emergency operations. When the fuel is used the pump carries two 500 lb. tanks in selected seats. Jet-fueling valves compressed air from the supercharger system. The intake valve is at 'A', the air passing through a selected valve 'B'. The pipe 'C' is a vent to the atmosphere, while the pipe 'D' leads to the fuel tank 'E'. To jet-fuel the fuel, the pilot closes the selected valve, sending the air into the tank, forcing the fuel out through the pipe 'F' which leads out through the tankers to the fuel.

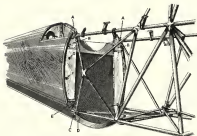


The intake vent for the fuel following system of the Junkers JU-52A-1 is shown at 'A' just below the rubber in this illustration. The pipe is of heavy construction and carries on a good sealing point at its fuel side in case of failure of the retractable fuel wheel.



*Simplicity of the Engineering Research Corporation's "Dunlop" canopy design is shown in the sketch at left. The same lines "A" and "B" join the two oppositely angled tubes. The guard plates "C" maintain the canopy just far back for full and proper mount structural members. The tubes of the canopy are angled to run out from the fire as back to the fire section.*

*The loading gear from attachment of the Dunlop Aircraft's "Dunlop" is shown at right. The frame is at "A" and is built up of two inclined flat plates meeting the sides and joined at the top between two aluminum alloy angle sections "E". Each plate is reinforced at the bottom by angle sections "C" riveted along the edges. The canopy angle sections frame members "B" and "E" afford support of the end of the frame. The loading gear end is attached by bolts at these points "B".*



*The method of attaching the slanted struts of the canopy to the welded tubular end section of the Dunlop Aircraft's fuselage is shown at left. Two bolts at points "A" on each side of the canopy angle for connection at the top, slanted plates "B" pick up the lower level in the end and take it out through the upper fitting. At the lower connection "C" the tube flanges out and two bolts are used, running vertically through the tube. "E" is a metal plate covering the main reinforcing function as the plates "B" at top connections. "D" is a pulley bracket and bolts "F" and "G" are bolts for control cables. (Also see AVIATION'S Sketch Book for August and September, 1942.)*







Aviation's  
Engineering Data Book

## Machining Aluminum

### Cuts, Speeds, and Feeds When Machining Aluminum Alloys

Use (a/c)	Rough Marking			Finish Marking		
	Max. Cut Inches	Speed (fpm)	Feed, Inches	Cut, Inches	Speed (fpm)	Feed, Inches
Leaves, Turnover						
Type I castings, not heat-treated	0.15 (a)	300 to 800	0.025 to 0.036	0.002 to 0.040	Maximum 600 to 800	0.003 to 0.005 to 0.002 to 0.012
All others	0.19 (a)	600 to 800	0.037 to 0.039	0.002 to 0.019		
Miscellaneous						
Type I castings, not heat-treated	0.25	600 to 600 (b) 300 to 700 (c) Maximum (d)	5 to 15 (e)	0.019 to 0.023	300 to 700 (f) 300 to 700 (g) Maximum (h)	16 to 25 (i)
Type II castings heat-treated						
Type III castings	0.25	600 to 600 (b) 250 to 300 (c) Maximum (d)	4 to 39 (e)	0.043 to 0.024	300 to 700 (f) 300 to 700 (g) Maximum (h)	5 to 18 (i)
Type I and II wrought alloys, heat-treated						
Type III alloys	0.25	300 to 300 (b)	3 to 4 (e)	0.001 to 0.005	300 to 700 (f)	4 to 16 (i)
Forgings						
Light duty (1 to 2 inches)	0.08 (a)	Maximum (f)	0.013 to 0.020	0.000 to 0.020 (g)	Maximum (j)	0.000 to 0.005
Medium to heavy duty	0.25 (a)	600 to 3000	0.007 to 0.012	0.000 to 0.020 (g)	300 to 3000	0.000 to 0.003
Structural						
Heavy duty (3 to 6 inches)	0.25	Maximum (f)	0.012 to 0.009	0.000 to 0.005	Maximum (j)	0.000 to 0.003
Light duty (3 to 6 inches)	0.25	Maximum (f)	0.025 to 0.009	0.005 to 0.005	Maximum (j)	0.000 to 0.010

Notes: See table below for explanation of Type numbers listed above in flow release.

(a) Cast associated in release.	(b) For carbon steel tools	(f) Peripheral speed of tool is maximum
	(c) For highspeed steel tools	(g) Most machines
	(d) For coated carbide tools	(h) Travel of ram
	(e) Travel of work	(i) Speed of table

### Types of Commercial Aluminum Alloys With Respect to Machinability

Type*	Alloy Alloy			
	Casting Alloys		wrought Alloys	
	Non Heat-Treated	Heat-Treated (a)	Non Heat-Treated	Heat-Treated (a)
Type I (Al-12%Si-1%Cu-0.5%Mg-0.1%Fe-0.05%Mn-0.005%P-0.005%S)	120	220 (b)	115	215
	C154	224	116	216
	545			217
	5515	225	117	218
Type II (Al-10%Si-1%Cu-0.5%Mg-0.1%Fe-0.05%Mn-0.005%P-0.005%S)	112	D195	905	905
	219	835		
	A215	105	A205	104
	300	H104	106	106
	12	1070	106	106
	214	1070	107	107
	202	1070	107	107
Type III (Al-9%Si-1%Cu-0.5%Mg-0.1%Fe-0.05%Mn-0.005%P-0.005%S)	H214	1070	107	107
	172	505	505	45
	A504	A505	506	A50
	504	506	150	40
	505	A150 (c)	150	41
	40		505	42

Notes: \*Type I alloys have two tempering characteristics.  
(a) Heat treated to a specific yield, usually a solution treatment followed by aging at room or elevated temperature.  
(b) After 220 is not aged.  
(c) Alloy cuts freely, but **must** as tools may be excessive unless they are tipped with resinated inserts.  
(Continued on page 184)

# Specify the HARVILL PLASTI-SEAT

and save **METAL** for places where metal can't be substituted

## ALL FACTS TO CONSIDER

1 Made of proven plastic materials

2 Greater strength and durability

3 Conforms to Spec AN 7505

4 Cost less per unit

5 Equal or less weight than metal

6 Easily adapted to design changes with little tooling expense

Here's the answer to the industry's urgent need for a seat that not only conserves vital materials . . . but equals or surpasses all the requirements of Spec AN 7505. Sturdily constructed of special plywoods, fabrics and plastic . . . yet as light or lighter than seats in metals or other materials. Because of the simplicity of construction . . . the basic idea of this phenomenal seat may be easily adapted to special designs with little tooling expense.

## INVESTIGATE AT ONCE

Complete information to qualified individuals



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SHEET NUMBER  
CLASSIFICATION  
SUB CLASSIFICATION

P-2 (Cont'd)  
Procedures  
Aluminum

## Machining Aluminum

General Characteristics of Tools for Aluminum

Although the machining properties of the various aluminum alloys differ, the principal differences between aluminum and most other metals with respect to the tools required are characterized as follows and should be carefully observed:

1. Thread runs top and side rake on the cutting tool thus is necessary for machining steel.
2. Many cutting edges sharp and free of burr or wire edges.
3. Chisel-like smooth, single tool surfaces free from corrugations.

### TOOL MATERIALS

Tools of plain high-carbon steel frequently perform satisfactorily when machining aluminum and most of its alloys. Under conditions in which the cutting speeds are necessarily low, they may be the most economical and this is particularly true for small diameter drills. For quantity production work, tools made from high-speed steels have longly replaced the carbon steel tools, but in many instances, tools tipped with resin-bonded carbides have proved far superior to high-speed steel tools. Tools of this last type are especially suited for the machining of aluminum alloys of high alloy content; in fact some of these alloys cannot be machined successfully under production conditions without it. The resin-bonded carbide tipped tools, when ground to proper rake angles, produce a finished machined surface that runs in sharp for long periods of time without resharpening; consequently these tools are economical for high rate production. The use of resin-bonded carbide tools is, of course, restricted to operations in which the work is free from vibrations and longitudinal to the cut.

### TOOL SHAPES

In general, the larger rake angles are employed for ductile but weak and for the aluminum alloys that are not too strong; this includes the other materials which require tools with exceptionally acute and free cutting edges. On the

other hand, rake angles in the lower range are used for tougher cuts and for machining the alloys that have free cutting characteristics. Tools similar to those used for machining steel may often be employed successfully.

The rake generally varies from 20 to 40 deg. Tools badly finished surfaces may be produced with tools having a top rake angle in the upper end of the range, but, obviously, such a tool can be used only as a finishing tool or simply flat from vibration, and which has no net action in the feeding mechanism. For some operations it may be necessary to use a top rake angle that is not so great as the above range, but a negative rake should never be used.

Side rake is important in machining aluminum and its alloys as this prevents a strong surface which is especially objectionable in grinding the cutting from the finish. A side rake of from 30 to 35 deg. works satisfactorily in the cutting action of the tool. Flank cut chips may have a considerable amount of side rake, holding some tools from ground with a side rake as high as 60 deg. in order to take full advantage of the free cutting characteristics of aluminum.

The clearance should be about 8 to 10 deg. This clearance must be carried around the side of the tool which advances into the work. This angle is important; if too small, the side of the tool will rub against the work and generate heat. If too large, the tool may tend to dig into the work or chatter.

In all cases it is essential that the cutting edge be keen, smooth, and free from grinding wheel marks, burrs, or wire edges. Too much emphasis cannot be given to tool finish, because it depends, to a large extent, the success of machining aluminum and its alloys. Rake angles are best obtained by finish grinding in a machine very fine diamond wheel that hand dressing with a fine or very fine abrasive, or lapping, taking care that neither the angles nor the contour of the cutting edges are appreciably modified during the finishing operation. Where possible, resin-bonded carbide tools should be resharpened.

### Mechanical Finishing of Aluminum Alloys

	Brazing			Grinding or Offing	Buffing	Polishing	Flame Finishing
	Solid Weld	Clack Ins	Solder Alloys				
Aluminum	Alloys or Sd	Alloys	Alloys	Turkish Emery	Trapp	Flax Lint or Soft Alloys	Sd
Cast	Solid Weld	Clack Ins	Solder Alloys	Solder Alloys	Trapp	Flax Lint or Soft Alloys	Sd
Cast	10 to 100	40 to 200	40 to 50	120 to 240	120 to 240	120 to 240	40 to 60
Cast	Fluxless Resin	Glass	Glass	Glass	Glass	Glass	Verfined
Cast	Mechan	Mechan	Mechan	Mechan	Sd	Very Sd	Sd
Cast	10 to 100	40 to 200	40 to 50	120 to 240	120 to 240	120 to 240	40 to 60
Cast	Fluxless Resin	Glass	Glass	Glass	Glass	Glass	Verfined
Cast	Mechan	Mechan	Mechan	Mechan	Sd	Very Sd	Sd
Cast	10 to 100	40 to 200	40 to 50	120 to 240	120 to 240	120 to 240	40 to 60
Cast	Fluxless Resin	Glass	Glass	Glass	Glass	Glass	Verfined
Cast	Mechan	Mechan	Mechan	Mechan	Sd	Very Sd	Sd
Cast	10 to 100	40 to 200	40 to 50	120 to 240	120 to 240	120 to 240	40 to 60
Cast	Fluxless Resin	Glass	Glass	Glass	Glass	Glass	Verfined
Cast	Mechan	Mechan	Mechan	Mechan	Sd	Very Sd	Sd

\* Mechanical finish required to complete - to be provided by customer

From "Machining Aluminum Alloys," Aluminum Company of America



★Photograph courtesy  
Wright Aeronautical Corp.

## X-RAY EQUIPMENT

*used for Inspecting Parts in*  
**CYCLONE ENGINES THAT POWER  
OUR FLYING FORTRESSES**



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**Complete Automatic Control**

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and closes the doors, moves the  
dollies in and out, and exposes  
the films at the correct intervals  
—all automatically.

**T**HIS new, compact X-ray unit was designed by  
KELEKET engineers for inspecting light or heavy  
metal parts on a fast assembly line. Speed is lim-  
ited only by the rate at which the dollies can be  
loaded and unloaded — up to 5000 small parts have  
been radiographed in a single 8-hour shift.

This fast, efficient X-ray inspection tool is built to  
operate with your present assembly line, or can be  
adapted to any mass production operation.

KELEKET engineers will be glad to consult with you  
on any problem requiring high-speed X-ray inspec-  
tion and explain how this equipment can be adapted to  
meet your requirements and specifications.

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harvested carrying work) both as

harrows carrying work both in which are provided automatic lubrication by pump mounted in column. For various sizes of work gears, vertical adjustment of roller-bearing axle is made by means of screw on cylindrical hand wheel, and adjustment provides constant check of wear of the roller product. Pressure bearings on roller spindle may be adjusted with vertical dressing roller head. The



DECEMBER

AVIATION 104 W. 43rd St., New York, N. Y.

### INFORMATION TIPS

Flows used as additional information described as identified by key numbers circled

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
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## NEW PRODUCTS

Please send me more information on Flow Product's monitoring in my numbers listed

36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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46 48 46 47 42 47 38 31 32 33 34 35 36 37

NAME \_\_\_\_\_

**TITLE** 10-00000-1-1000 Page 100 of 1000

COMPANY OR AFFILIATION \_\_\_\_\_

ADD1911

CITY AND STATE \_\_\_\_\_

**Alloys**  
 Fifty-odd Dymond-Wood's, published by Bridgeport Brass Co., Bridgeport, Conn., has just come from press. Eighty-two brightenings contain data and applications for five different Dymond alloys supplied in sheet, stock, wire, tubing, and pipe. Includes numerous composition specifications, curves and tables.

Low prices on a rich 226-page catalog have been prepared by National Screw & Bolt Manufacturing Co., Cleveland. A 76-page association publication gives full information on computer bolts, turn screws, plating etc., used in aircraft industry.

**Metal Parts Washers.** Various types of Detrex washers are used with alkaline cleaning compounds to clean engine parts and aerodynamic components. They are produced and distributed in two sizes: fuselage washers by Detroit Rex Products Co., 14000 Wilshire Ave., Torrance, Calif. 90501; aircraft washers, which are given

**Radio Motors** 4  
October 10, 1944 issued to Carter Motor Co., 1033 Milwaukee Ave., Chicago, the title and does not demonstrate, construct and keep portions for the maintenance. Some alterations in design

**Calendar** "Lipstick date dates" are feature. Ann "Lipstick" 1911 Weekly (Lipstick) prepared by Frederick Post Co., Box 10 Chicago. Dated also is 1912 (Lipstick) 1912 (Lipstick) date of value to register's is included.

**Forge Wielder** This recently announced title is about slated to offer new approaches to its audience's writing, as described in *Writer's* 14. BAI released by Progressive Field Co., 2000 E. Outer Drive, Betts, Co. based automatically constructed upon writing and best reading of this novel. special feature of most. *Writer's* should like drawings at the example electronic typed words made with soft, computer of high-contrast, degree of without phase shift back motion, etc.

**Florida Drill Bits**  
 Rebar 10, 12 and 14, made from the same materials as the Rebar, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834

**Aero Engine Overhaul**  
 Fundamental and procedures for inspecting method of disassembly and developing overhaul and other engine parts. Overhaul is described in 14 page booklet recently issued by Turco Products, Inc. of Los Angeles and Chicago. *Turbo Products for Aircraft Engine Overhaul*, includes many diagrams and photographs.

AVIATION, December, 1941

**Mercuria Data.**  
Information on design and selection of Mercuria light, slating and roof-covering material plastic, is contained in 28-page Booklet B-1145 offered by Worthington Electric & Mfg. Co., East Pittsburgh, Pa.

**Barrel Pump**—  
Engineering Bulletin No. 455, issued by  
Traylor Engineering Corp., Cleveland, de-  
scribes company's new electric-hydraulic  
pump for pumping oils or greases directly  
from original containers. Pump operates  
from any electric outlet.

**Roofing Ring** 11-100-1200000  
 Reform on its new bonding ring available from Canton Electric Development Co., Los Angeles. Ring is used extensively at present in bonding shield cable and instrument wires. May be used with shield flexible conduct coupling nuts or cable clamps.

**Drawing Problems** ..... 1  
 Drafting for Victory is title of new series of folders, prepared with cooperation of aircraft manufacturers, offered by Eagle Bond Co., 300 E. 10th St., New York. Folders deal with mechanical drawing problems. For basic instructions on

**Tooling Set-Ups** Details of ten different set-ups for Universal lathe tooling showing ways tooling can be used to save tooling cost and time are presented in new edition of hand-pipe brochure offered by Experimental Tool Die Co., 18605 Greiner Ave., Detroit.

**Alloy Chart**—Analysis, physical characteristics, and applications of 18 different stainless steels. Steel, and nickel alloys are included. Compact chart available from The Copper Alloy Foundry Co., 800 Hwy 84, Maitland, N. J. Also gives an handy cross-references of designations and type numbers of stainless steels, including United States Navy, and others.

**Grinding Wheels** 1  
Twenty-one page photo-and-figure-detailed data booklet, Grinding Wheel Floor Construction and Selection, has been published by Mid-West Abrasives Co., 1811 E. Milwaukee Ave., Detroit. Describes various types of grinding wheel layout, and superabundant tables, as there are tables and charts detailing specifications, wheel speeds, spindle diameters and wheel weight.

**Finalists: Park Machine**—**1**  
Stomachs: Bertha shaft drives, the  
many new and specific applications, re-  
covered in turning to 29, early used by  
Fountain Electric Co., 31 Park Place, New  
York City, machines, grinders, and a  
crusher are covered in well illustrated  
two-page publication.

**Bearing Lubrication**—E. J. ... published by SKF Industries, Inc., Philadelphia, is a 32-page booklet that provides a guide to bearing lubrication. Thirty-two pages are filled with design, lubrication and graphing examples, highly technical questions, answers, and practical problems of correct ball and roller bearing lubrication.

**Flammable Aerosol Controls**—Handbook of instructions on how to install and maintain Flammable Aerosol Controls has been issued by Flammable Aerosol Controls, Inc., 18 Rock Hill Plaza, New York, aerosol aerosols and precision instrument maker. Special feature of Handbook is two-page drawing of typical control layout.

**Process Control.**—The Brown Instrument Co., Wayne at Belmont Ave., Philadelphia, has recently published a 44-page booklet titled *Top Techniques of Process Control in Industrial Processes*. (Booklet 50-1) Information on precision measurement, functions of control, types, and typical applications are offered. There are numerous schematic diagrams and illustrations of systems and apparatus.



## 19 PLACES TO GET A 50% SAVING IN ASSEMBLY TIME

To back up your industry with a continuously plentiful supply of one of your most in-demand items, a total of 19 screw manufacturers have been equipped to produce mass savings, trouble-saving Phillips Recessed Head Screws.

Tremendous manufacturing capacity... nationwide distribution... are augmented by a corps of 190 sales engineers, qualified to help you get the most from Phillips. In the average case, they can show you how to save 50% in assembly time—eliminate operations, prevent accidents, eliminate bottles, get stronger fastenings.

The shape, taper and depth of the Phillips recess were determined after thousands of tests. The driven maximum ransing power is utilized without sacrifice of strength in the screw head... without danger of shearing the metal or breaking the bit. That's why the majority of auto turned out by leading engine and automotive concerns are Phillips-assembled.

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BY SAVING ASSEMBLY TIME...  
SPECIFY PHILLIPS AND  
SAVE 50%**



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Order stronger, cost-cutting Phillips from any of these sources

### 19 SOURCES OF SUPPLY

**Anchor Screw Co., Providence, R.I.**  
**The Ideal Co., Watertown, Conn.**  
**United Screw Co., Detroit, Mich.**  
**Chandler Fastener Inc., Vancouver, B.C.**  
**Best Manufacturing Co., New Bedford, Mass.**  
**The Green Screw Corp., New York, N.Y.**  
**International Screw Co., Portland, Me.**  
**International & Specialty Screw, Cleveland, Ohio**  
**The Midwest Screw & Bolt Co., Cincinnati, Ohio**

**San England Screw Co., Miami, Fla.**  
**San Electric Screw Co., Montreal, Quebec**  
**Seaton Screw Corp., New York, N.Y.**  
**Parsons Screw Co., Pasadena, Calif.**  
**Best Manufacturing Co., New Bedford, Mass.**  
**Parsons Screw & Bolt Co., New York, N.Y.**  
**Parsons Manufacturing Co., New Bedford, Mass.**  
**Shawmut Screw Co., Chicago, Ill.**  
**The Lancaster Screw Corp., Lancaster, Pa.**  
**Widley Screw Corp., Montreal, Quebec**

respiration are available. Specifications: Cutters: steady, spindle speed, 200, 300, and 500 rpm; work table, length of travel (one stroke) 0 to 1 in.; strokes per cycle, 4, 6, or 8; table feed strokes per min., 10, 20, or 30—Aviation, December, 1942.

### Plywood Plastic Curer 27

The use of plywood being suggested in the aircraft industry, attention is drawn to Vitapac Chamber offered by American Tool Machinery Co., 519 E. 42nd St., New York, for curing laminated (but form) plywood, plastic, and acetone. The illustrated, 40 in. x 64 in. x 64 in. deep, is used to make



ing of airplane parts. Water reports availability of chambers in diameter dimensions of 36, 48, 72, and 90 in., and special materials may be secured for special custom jobs of other sizes. Positive seal, quick closing and locking doors are features of units, which are built for 90-lb working pressure. In addition to straight sheet stock, chambers may be used for high-pressure, low-temperature curing through a continuous acetone acetone solution. Aviation, December, 1942.

### Drill & Bore Machine 28

Model 445, new independent, two spindle, deep hole drilling and boring machine, constructed by W. Z. & John

Barnes Co., Rockford, Ill., is designed to drill or bore two parts simultaneously in completely independent cycles. Supported by separate steadyrests, each workpiece is driven by independent toolholders. Tools are fed by independent hydrostatically actuated slides. Normally, four-jaw, 15-in.-dia. chucks are furnished, but those of 24-in. dia. may be used. Seven adjustment on designed rollers permits handling 5-in. to 24-in. o.d. work. Steadyrest tops are hinged to facilitate workpiece handling when loading and unloading. Hydraulic feed cylinders on base are actuated by two molecular hydraulic feed and traverse units. Specifications of machine, which may be completely controlled from each of four positions stations, follow: Stroke 48 in.; swing 20 in. dia.; length of part 13 1/2 in. max.; tool run in dia.; spindle centers 70-in. dia.; spindle height from base 20 in. dia.; spindle hole 1 1/2 in. dia.; and approximate weight 55,000 lb.—Aviation, December, 1942.

### Cutout-Coil Welder 29

Low price price tag of \$2 is feature of "Double Top" portable, instant-removal AC welding machine offered by Wilson Welder & Metals Co., 68 E. 53rd St., New York. Two 40-lb. primary coils are used, with magnetic resistance to prevent fire. However, one primary automatically cuts out when machine is off, only being thrown into circuit when electrode contacts work. When operation draws on, open circuit potential of two primaries (94.32 v.) enables him to establish arc quickly and begins welding. On pulling out are at terminals of welding (lead of which ranges between 22 and 46 in.) are voltage eyes, but no reaching 45 v., one primary cuts out. Power factor correction in this size unit is provided by built in capacitors on all four sizes—300, 400, 700, and 1,000 amp—when thrown out cut when



machine is off. Welder has dual voltage connections for either 220 or 440 v., control and assures thermal overload protection, and hand-held control with current adjustments throughout NEMA range—Aviation, December, 1942.

### Cylindrical Finisher 30

Wide variety of applications is featured by the "OD" (outside diameter) cylindrical finishing machine introduced by Bennett Machinery Builders, 1818 Douglas Ave., Kalamazoo, Mich. Arrangement of machine with spiral wheel polishing member is illustrated.



Machine may also be set up with back stand after pulley and polished support. In contact wheel permitting use of surface contact abrasive belt,



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**TENUE ALUMINUM CASTINGS** are proving their worth on fire-fighting battle fronts in planes... tanks... ships. And our castings will "come through" under all conditions because of our ability to meet the most rigid specifications of the armed service with speed and quantity production. This will be your guarantee of receiving quality sand and precision-mold aluminum castings when our shipping tags can again read: Destination U.S.A.

*Illustration shows sandless water pressure testing of an important aircraft aluminum casting.*

**TENUE**

**THE National BRONZE & ALUMINUM FOUNDRY CO.**  
CLEVELAND, OHIO

NEW YORK, 101 Broadway • CHICAGO, 100 W. Randolph • DETROIT, Stephenson Bldg. • LOS ANGELES, 405 S. Hill  
MAKERS OF QUALITY SAND AND PERMANENT MOLD ALUMINUM CASTINGS

growing size face of wheel and to back stand for finishing and polishing using additional materials and clamps of various sizes. New abrasive belt method is said to effect striking savings while increasing production. Unit is designed with range of feed of 3 to 50 in. per min. for 1-in. dia. forward or reverse, permitting good production by using "gross" operations. There is simple adjustment of work support to wheel for change of varying diameters. Work support may be firm's standard or one specially built for customer's requirements. — *AVIATION, December 1942*

#### Turret Lathe

A new, 8-in.-type turret lathe, designed for rapid production on close tolerances of small turning or lat work, is being introduced by the South Bend Lathe Works, Department 32, South Bend, Ind. Second operation work can also be handled efficiently, it is said. The lathe has a 13-in. swing over the bed or saddle section, 1½ in. hole through the headstock spindle and 1-in. hole capacity. It is equipped with both compound rest cross slide and a hand-crank cross slide, which are interchangeable. Quick change gear box supplies 48 longitudinal power feeds for the universal carriage, 48 power cross feeds for the compound rest cross slide, and 48 thread making speeds, 4 to 220 per inch. There are twelve spindle speeds ranging from 50 to 1,200 rpm. — *AVIATION, December, 1942*

#### Riveting Machine

To expedite fast riveting in aircraft production, the Tuckett Johnson Co.,



Jerome, Mich., has developed the Rivet, an improved machine with extensive feed and offset mechanism. All motions, supplied by electric, is applied and stopped up via a toggle motion is designed with square for just due to 1-in.-long stroke. Other features: Vertical adjustment of lower tooling without disturbing upper lower tooling alignment, also adjustable in height. Other features: variations in thickness of materials tested is used for automatically, while manual adjustments are provided for major variations. — *AVIATION, December 1942*

#### New Products

#### Tapping Machines

Line of high-production precision tapping machines — including both high-duty (Series LTM) and heavy-duty (Series HPM) types — has been

# RYERSON



**Reliable Source of  
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SPECIAL AVIATION  
STEELS**

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For example, recently eight seven beamers were held up awaiting delivery of 2½% rounds at WD-X4130. A Ryerson Steel-Service man was called to his home on a Sunday evening. Within a matter of minutes, Ryerson stocks in ten cities were being checked. All were temporarily

out of the desperately needed beam — all but one.

A shipment of 2½% WD-X4130 rounds was just arriving at one of the Ryerson plants. The car was immediately opened and the same evening the steel was on its way to the airplane builder. A production headstock was broken.

When steel is needed in a hurry — and it often is, under pressure of war production — call Ryerson! If the required steel is so he had experience, Ryerson can, and will supply it!

**JOSEPH T. RYERSON & SON, INC.**  
Chicago, Milwaukee, St. Louis, Cincinnati, Denver, Cleveland, Buffalo, Boston, Philadelphia, Jersey City

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Plastic-Bonded Moulded PLYWOOD is ideal for many aircraft components. It has great strength, light weight, a smooth surface, can be moulded to practically any shape and may be reinforced for added rigidity. Inquiries from prime and sub-contractors are invited. Our Engineering Staff will gladly recommend how Moulded PLYWOOD parts can help you speed your production.

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Radio Mounting, Elmhurst, Illinois

Sheet Metal Parts, St. Louis, Mo.



designed and built by Detroit Tool & Tool Co., 5432 Madison St., Detroit. Though designed as "spindles," units lend themselves to variations, such as provision of single or multiple tapping leads, use for oil grooving, or long lead tapping. Inadvertent "reading" from lead-screw "wind-up" are avoided by use of lead screw which can't be required to drive any lower end of tapping spindle is guided through entire stroke to insure accuracy, to avoid excessive hole tapping, and to permit accurate precise deep-hole tapping. Lead duty type taps up to 3-in. dia. and 14 pitch to start, maximum strokes of and to 6 in., and three spindle speeds are provided ranging from 100 to 400 rpm. Heavy-duty machine has park-off change prism between spindle and main-drive gear first reduction for changing of spindle speeds. Maximum stroke is 8 in., and holder allows taps to feed automatically only, without end play. Maximum height of both ends may be varied, and peak, normal, or auto auto-operating indexing features are available. Intermittent tapping units, between left-hand (left shown) and heavy (right), may be obtained—*AVIATION, December 1943.*

### Control-Cable Tester 34

Drexler dynamometer scale for testing control cables for stretch, guaranteed tensile strength, and ultimate breaking strength is mounted by the Krom Co., Bridgeport, Conn., maker of dial scales. Scale has 50,000-lb. capacity and dial chart has 25-lb. graduations. Both indicating pencil and dead pencil remain in place to show ultimate testing strength following cable



rigidities. Assorted control cables are attached to each other and on-end and are round lead and both between top and bottom sets of ground sheaves. Control of hydraulic pressure, which produces cable tension, is at same end



of equipment as dynamometer scale, enabling rapid tests to run once. Shock absorber protects against back lash injury from cable rupture at full tension—*AVIATION, December 1943.*

### Production-Line Conveyors... 35

Drexler dynamometer scale for testing control cables for stretch, guaranteed tensile strength, and ultimate breaking strength is mounted by the Krom Co., Bridgeport, Conn., maker of dial scales. Scale has 50,000-lb. capacity and dial chart has 25-lb. graduations. Both indicating pencil and dead pencil remain in place to show ultimate testing strength following cable

## KOLD-HOLD



### The "G.H.Q." for Latest Stratosphere Data

For testing stratosphere instruments and parts under conditions duplicating those found at higher altitudes, make KOLD-HOLD your "Ground Based Quarter" for stratosphere information. The KOLD-HOLD Stratosphere shows here, on pressure control flying components and pressures at will . . . controlled accurately where and where you need them.

In addition, reliability is always excellent . . . you see SEE the performance of instruments and devices with testing points through the large Thermopane glass panel. Where requirements demand, stratospheric tests may be directed through the panel to allow down the screen and provide additional viscosity tests at the same time for checking and recording.

KOLD-HOLD's engineering service is ready to cooperate . . . and your requirements for complete recommendations.

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605 ANDERSON—605 W. Second—St. Paul, Minn.

**KOLD-HOLD MANUFACTURING CO.**  
1000 Third Ave. EASTMAN, MINN., U.S.A.

AVIATION, December, 1943

115

# NOW.. *Speed Nuts* for Plywood



## Faster Application • Lighter in Weight

• The need for the basic SPEED NUT principle of spring tension is even greater in plywood. SPEED NUTS have a WIDE BEARING SURFACE which eliminates the need of a spanner washer beneath the nut.

This new SPEED NUT FOR PLYWOOD No. 6279, illustrated above, is the only self-locking nut which can instantly be driven into anchored position. When driven into THIN plywood secures the attaching legs are "peened" over against a locking plate. When used with THICK plywood, the cone-like structure of the attaching legs forces them outward, as they are driven deeper into the wood. This gives the Speed Nut a firm spring tension grip on the wood. WEIGHING BUT 3 1/2 LBS. PER THOUSAND, they are available for use on both AIR CORPS 530-8 and AIR CORPS 530-10 sheet metal screws. Write for bulletin 168 and samples.

TINNERMAN PRODUCTS INC., 2070 Fulton Rd., Cleveland, O.



### Cylinder-Turning Lathe

Heavy-duty, semi-automatic, cylinder-turning lathe, constructed by Sparks Machine Tool Corp., 22 Main St., Norwalk, Conn. Accommodates six turning tasks on fixed, non-adjustable far more body turning, giving fully-automated operation including tool holding, and "taper" another six tasks on back slide, likewise worked automatically. Especially designed for turning of heavy machine parts, cylinders, such as has been used with four active speeds for work on different size cylinders, and motor has reduction gears for slow speeds when turning exceptionally hard cylinders material. Feeds are all controlled through rotating valves connected to operator. A treadle releases holding equipment.

Costed ready for shipment, lathe weighs approximately 33,000 lb.—*Aviation, December, 1942*

### Rapid Parts-Hardener

Further hardening of intricate design metal parts at rapid rate is feature purpose of Tocco-Jones induction-hardening machine offered by Tocco Division, Ohio Gearshaft Co., 3500 Harvard Ave., Cleveland. Pistons is estimated since shafts are placed on rollers passing them into electric induction. Machine has rotating mechanism permitting regular internal stoppage of shafts during internal induction hardening are so well defined, says company, that remainder of shaft is not heated, thus maintaining direct heat.—*Aviation, December, 1942*



AVIATION, December, 1942



## IF IT'S HEAT RESISTANCE YOU WANT

Robust collectors slugs, machine gun heat tubes and other products withstand enormous and high heat, they have longer service lives—thanks to Carpenter-Welded Stubless Tubing.

The unique wall thickness of this tubing means that there are no thin spots in "burn out" line. And it is a durable, easy to fabricate—thus helping to speed the production of vital wartime equipment that must not buckle against excessive heat. Then too, when an actual design calls for it, parts can often be finished by merely swaging, tapering, expanding, etc.

If you have a wartime heat resistance problem that must be solved right now, take advantage of Carpenter's diversified experience in many phases when similar problems have been met and solved.



FOR HELP in solving Welded Stubless Tubing and for our entire "Quick Force" literature. They include practical working information to help you with any design and job casting problems. If you are now company literature will show you all "Quick Force" literature in the way to your end.

CARPENTER WELDED STUBLESS TUBING comes along and they specializing, repair, cast, pipe, heat, every in 1970. Absolutely latest.

THE CARPENTER STEEL COMPANY  
Welded Alloy Tube Division  
Eastworth, N.E.

**Carpenter**  
WELDED  
STAINLESS TUBING

THE FASTEST THING IN FASTENINGS! *Speed Nut System*



## SHOP EQUIPMENT & ACCESSORIES

### Arc Control Stations 38

Wilson Welder & Metals Co., New York City, reports greater welding output per machine, better control by operator, and improved welds on thin wire metal through use of its Heavy Two Arc control station. Stations are made in 150 and 250 amp. capacities. Two or four units (see photo) may be



be used in single position for operation of a like number of arcs simultaneously. Each operator may act to deliver definite current as for steady welding, or work hand switch to stop run current without breaking arc, enabling heliarc steel or mild steel with addition of current on work screen up. 15 lbs. in current, each operator can regulate own current. And remote control at end of lead, permits improved quality of weld deposit at joint.—*AIRATION*, December, 1942.

### Crane-Truck Combination 39

Designed to perform the functions of a load carrier crane and tractor, the new unit manufactured by the Elwell-Parker Electric Co., Cleveland, Ohio, has an unbalanced platform 48 in. wide x 50 in. long x 20 in. high. Crane capacity is 1200 lb. at 42 in. on the boom, tractor speed is 5 mph. It operates with two-wheel drive and four-wheel gear. Frame is made up of heavy section formed plates welded into integral structural unit embodying motorized dais.—*AIRATION*, December, 1942.

### Two-Way Radio 40

Two-way aircraft radio, consisting of three separate units for use of individuals, is announced by Electronic Specialty Co., Los Angeles, manufacturer of Ranger radio line. Set includes Model 562 power supply operating from a plane's 12-v. storage bat-

tary Model 110 receiver which has both 180-450 Kc band and spot frequency provision to 1350 Kc, and Model 365 70-5 mc output transmitter operating on 1185 and 6215 Kc. Units are connected by flexible cables permitting considerable flexibility in installation. In addition to "spot" frequency, receiver is equipped with two-way telephone circuit for communication between pilot and observer. Three units combined weight 18 lb. 2 oz.—*AIRATION*, December, 1942.

### Power Lift Truck 41

A new electrically operated lift truck called the PowerQx marks entry into the power-driven lift field by Russell-Corbin Co., 2551 W. 38th St., Chicago, Ill. Capacity of the new unit is 4000 lb., width is 20 and 25 in., platform lengths are 48 and 56 in., and lowered heights are 7, 9 and 15 in. Two electric motors drive rear wheels independently. Left mechanism is the standard Barrett unit of multiple stroke design. Batteries provide for 8 to 12 hrs. continuous operation. Motor power is supplied by hand, manual-forward or backward limit of the wheel determining direction.—*AIRATION*, December, 1942.

### Small Air Clamp 42

Convenient-sized air clamp delivers 80 lb. pressure on hose pressure of 100 lb., has been designed for strength economy by Mead Spaulding Co., 15



5 Market St., Department M-37, Chicago. Known as Mead-Might unit is for assembly, repair and other multiple applications. Borehousing and Discharge Lock-up and release of accessories is said to be instantaneous, one-man wire pressure installation in cramped quarters, special adjustments are stated to be unnecessary since air clamps snap holes with equal pressure at any point along bulk. Group of units can be controlled independently of other groups in given installation. Size of the run is 1/2 in.—*AIRATION*, December, 1942.



**DUAL ROTATION**

**CURTISS ELECTRIC PROPELLERS**



## NAVY'S NEWEST DIVE BOMBERS CLIMAX *23 Years* OF PIONEERING

Twenty-three years ago U. S. Navy aviation pioneered precision bombing with fighter planes aimed at the target in a dive. By 1935 the U. S. Navy was developing aircraft especially designed to withstand the unprecedented stresses imposed by this new technique. Fleet squadrons were performing regular training operations in dive bombing tactics.

Today this war-tested background of experience, technical development and experience has made possible the modern dive bombers now in production by Brewster and other manufacturers.



**BEECHER AND HERMIDA DIVE BOMBERS**



### Wage and Cost Calculator 43

Payroll and job costs are stated to be calculable in fraction of usual time through use of device offered by **Wage Breaker Co.**, 413 S. Spring St., Los Angeles. Calculator includes all hourly rates of pay from \$6c. to \$1.75, with 1c. spread between rates. It covers all time periods up to 394 hours with 1/18-hr. divisions.—*Aviation*, December, 1942.

(In concrete steel and expedite ship yards) on premises up to A-19 steel containers require A-12 or better.—*Aviation*, December, 1942.

### Bar and Part Store 46

For measurement and storage of long bars and odd shaped parts, the **Diase Metal Mfg. Co.**, Canton, Ohio, has developed a special universal universal stand. Applicable for several plant use, unit was formed from company's standard all-steel steel platform, turned upside down and equipped with eye brackets for insertion of stress hooks.—*Aviation*, December, 1942.

### Engine Assembly Stand 44

A new engine assembly stand, known as the Model E2, for holding large inline aircraft engines in any desired position during assembly or overhaul, is now being manufactured by the **Aviation Division, Whiting Corp.**, New York. Its important features are the rotating rings and horizontal tubular members to which the engine brackets are bolted. This design reduces the stand's requirements for a minimum and provides complete accessibility to all parts of the engine at all times during its buildup. The engine is quickly and easily bolted into position and the entire unit is readily maneuverable in the production line or other assigned place.—*Aviation*, December, 1942.

### Metal Cooling Coolants 45

A new line of useful cooling media has been developed by the **Gray-Mills Co.**, Chicago, Ill., making their nationwide distribution outlets to offer immediate deliveries from stock. Backing the convenience to many shops in purchasing large quantities, the new Gray-Mills "Flo-Bud" coolant can be offered in a wide range of container sizes: 3, 5, 10, 20, 50 and 100 gal. They are manufactured in four types to cover particularly every requirement and are available in various quantities.



### Rivet Sets 47

Replacement of its line of American rivet sets to include practically every type known to be in use in aviation industry is announced by **Aircraft Tools, Inc.**, Los Angeles. Line now includes all standard sizes of straight-type round head, hex head, flat head, and modified hex head. Size 6 to 1/4 in. dia.; offset-type with round head,



hex head, flat and modified hex head from 6 to 1/4 in.; screw type both rivet sets, straight, both rivet sets with 1/2-in. heads, and both rivet screw sets in 1/4, 1/2 and 3/4-in. round and hex head.—*Aviation*, December, 1942.



### Junior Pneumatic Vise 48

New addition to line offered by **Precision Borens, Inc.**, Pontiac, Ill., is the **Junior pneumatic vise** for milling, drilling, tapping, filing, and assembly operations. Quick setting for speedy operation, and is stated to offer these features. Adjustable screw adjustment to locate adjustable jaw bolts in lock jaw in position, reduced mechanism to afford protection from chips or foreign elements, and key-locked design for precise work. Specifications: Maximum throat 10 in.; jaw width, 4 1/2 in.; depth 1 1/2 in.; weight approximately 25 lb.; and gripping force on work approximately 30 tons per line pressure. Drawing back 1/4 in. of gas travel.—*Aviation*, December, 1942.

Speed  
Accuracy  
Low In Cost

**HONE  
TO VICTORY**

Super-Smooth  
Finish  
Inexpensive  
to Operate

*With* **THE SUNNEN  
PRECISION HONING MACHINE**

**SPEED** to meet today's ever-increasing demand for vital implements of mechanized war.

**ACCURACY** to insure fewer rejects and absolute interchangeability of parts. Super-smooth finish.

**LOW COST**—Both initial and operating.

**WIDE RANGE**—Honors any external diameter from .185" to 2.400".

**EASY TO OPERATE**—Workers in "green"—even girls—can be trained to do expert work in a few hours.

**CONVEYERS**—Relieves big internal grinding for other jobs. No fixtures needed—work held in hand.

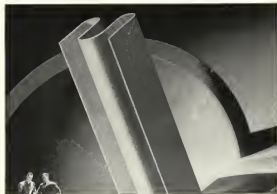
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a Sales Engineer will be glad to call with  
his demonstrator and show you what this  
machine can do on your job.

**SUNNEN PRODUCTS CO., 7842 Woodward Ave., St. Louis, Mo.**  
Canadian Factory: Chatham, Ontario



Here's something else that  
*"Couldn't be done"*

WITHOUT fuss or fury, many  
industries have been overcome  
in the manufacture and use of plastics.  
Molded INSUROK parts, for example,  
are being produced in large  
quantities for war uses so important  
that they cannot be mentioned. And  
now laminated INSUROK is being  
formed into "acorn-like joints" and  
other shapes to solve another category  
of production problems.

In addition to extending the ways  
in which INSUROK can serve the  
armed forces, *Richardson Plastics* are  
helping designers take full ad-

vantage of this versatile material, are  
helping many manufacturers increase  
their output per machine hour.

If you have a problem which  
molded or laminated plastics might  
solve, write us. We'll be glad to furnish  
the details and characteristics of  
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give you the benefits of our experience.

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**INSUROK** and the members of *Richardson  
Plastics* are helping war products pro-  
duce us fast.

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4. Enabling other critical materials but other important jobs.
5. Providing greater freedom for designers.
6. Solving design jobs "that's too hard."
7. Solving or preventing machine and product problems.

**INSUROK**

MADE AND SOLD ONLY BY THE RICHARDSON COMPANY

AVIATION, December, 1942

AVIATION, December, 1942

261

The Lunderberg ships  
to achieve parts machining for engine  
work, however, in the early 1970s  
they began to produce their own  
parts.

Exuviae often (001 or 002) look  
perfectly hexagonal, beaded into  
a solid unit) are still in your spec-  
ifications.

**Laminated Shims Company**

Incorporated  
At Salem, Mass.      Chartered, 1882



**LAMINUM**  
THE ONLY ONE THAT FEELS  
ADJUSTABLE

## Cushion-Bonded Clamps 49

Customized and integrally bonded clamps meeting AAF specifications are being produced by Automatik Rubber Co., Department A, 6051 Eganville Blvd., Detroit. Bonding is provided by using bonding strip attached to clamp securely by spot welding. Neoprene



conditioned clamps are specially constructed Neoprene peroxide resin resin material with maximum resistance through wide temperature range. Clamps may also be supplied with felt leather, or plastic covers. —AVIATION December, 1942

## Exploding-Rivet Gun 57

Manufacture of new electric locomotives for expanding system in hard-to-reach parts of planet is announced by Westinghouse Electric Appliance Division, East Pittsburgh. Note that by test with special dePrest river sets of chassis within 2 to 3 sec. Delivered



parts of unit are modifications of key parts of electric ranges and household irons made in prototype. Operator selects temperature needed depending on size of rivets, and gun's firing time can be controlled to gain full force of arc—*ASTRONOMER*, December, 1941

## Skin-Assembly Gun 51

For assembling their holders to an swift shoots, Frustite Division, Detroit Harvester Co., Toledo, has produced Frustite Safety Champ gun. Light weight and balance of steel mechanism inside, steel compound, making it ex-



perfectly suitable for women workers and automatic gun-lugs grip provide greater leverage. Pistons in two standard-bored, replaceable ships of waste. One accommodates all popular sizes of shoe holders.—*ARMSTRONG* December, 1942

## Aircraft Varnish . . . . . 52

T-110 aircraft launch has been developed by the **Widow & Williams Co.** Park Square Bldg., Boston, to meet Army-Navy specifications AN-TT-5118 for launch for use primarily on wooden surfaces, such as plywood used in plane production. Specifications for launch protecting valuing of green plywood and which will not check or peel is wanted to be sent to letter by T-1105—ANNOUNCER, December 1942.

## Hydraulic Valve ..... 51

Designed to permit installation in multiple hydraulic circuits in limited space, such as cockpit control panels without external weight increase, the new Stamping Midget valve measures 1 1/2" x 1 1/2" x 1 1/2". Add Precision Products Corp., 300



Mark, Calif. Comparison to previously announced HighJet Model four-way selector valve, new standing valve measures 28 1/2 inches in height and weighs 29 lb. Individual valve assemblies may be replaced or repaired by knowing only two cylinder lines affected. Fixing as single body, any number of units may be changed together by means of "through" bolts and washers which also serve as Spenco, an experimental design permits latching and locking in most desired shut arrangements. Over cover is provided by a tapered plate mounted on cam shaft. Complete interchangeability of valves and assemblies among various sizes ease and reduce parts stock in automats.—*Associated Press*, December 19, 1954.

## Line and Cable Grommet . . . 5

Prices and waterfront support for steel and hydroelectric loans, electrical supplies, flexible remote control equipment, is handled with Dura-Gum gross and, according to *Asnes Outlook*, Inc., 222 S. Michigan St., Chicago, motor unit, consisting of oil-reducing type rubber tubes and continuous piece steel cup windows, ships over 100 miles, or tube and the empty space wall. Multiple have may be supported by single movement, with individual opening provided in ducts for use line.—*Asnes Outlook*, December, 1942



### Where Women are Employed In Industry

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★ If you are considering employing more women in your plant, you can convert most manual lifting operations, make tough jobs easy, and speed up your output with Carlini AZ Powered Hoists.

Many heavy lifting jobs, formerly requiring male labor, may now be accomplished quickly and easily by women, using Carma equipment.

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Floods of war production plants have increased production efficiency, reduced worker fatigue, saved thousands of man-hours by solving many material handling problems with Gerd's equipment. Write for full information and free booklet, "How Air Power Is Being Used in Your Industry."



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## TEST AND CALIBRATION CHAMBERS

DESIGNED TO SATISFY ARMY & NAVY REQUIREMENTS

**POSITIVE AUTOMATIC MECHANICAL MEANS PROVIDE:**

- ★ LOW TEMPERATURES TO -100 F
- ★ HIGH TEMPERATURE +150 F
- ★ TEMPERATURES AUTOMATICALLY HELD WITHIN  $\pm 2$  F. OF SELECTED SETTING.
- ★ ALTITUDES TO OVER 80,000 FT.
- ★ INTERNAL PRESSURES TO 30 lbs./sq. inch.
- ★ RATE OF CLIMB TO 10,000 Ft./Min.
- ★ HUMIDITIES AUTOMATIC OR MANUAL CONTROL

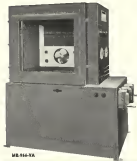
★ Standard Models are available in two sizes of clear visible text sizes:

left top Vol. ... left top right top  
middle top left bottom right bottom

MS 145 VM — 11 is MS 145 VM 11.5  
MS 145 VM 11.5 is MS 145 VM 11.5

Temperature Ranges for standard models are from +158° Fahr. to -49° F., -74° F., or -109° F.

\* Engineering department will gladly cooperate with you on any high altitude test or calibration problem or on special steel or pressure chambers.



**MOBILE REFRIGERATION INC.**  
630 FIFTH AVENUE NEW YORK, N. Y.

## River or Time-Cycle Unit

New Murray Time-Air, of which manufacturing and selling rights have been acquired by Chicago Freehold Tool Co., 8 E 44th St., New York, is device for mechanical determination of proper cooling time cycle. Developed by Murray Research Division, it is light, compact, precise and which



When attached to hands of parasites resting on one can be controlled by speaker either automatically or manually. After fast depression of trigger in automatic operation, timer delivers predetermined time cycle, then stops. By pulling trigger slightly back, hose operates as long as trigger is so held, permitting time-up or occasional longer cycles. Time cycles are set by small adjustment dial, and pressure control may be replaced for flow or soil moisture. Device may also be used as pressure system with foot-pedal control.—*Agriculture*, December, 1962

## New Power Package 50

Power package offered by General Electric Co., Schenectady, is designed to produce, in one unit, motor, brake



### Fluorescent Lights

**E. & W. Wiley, Inc.**, 177 Huron Ave., Buffalo, has developed fluorescent lighting fixtures employing a new method of ballasting and to give positive and in-





## Those curves look awfully good!

"Good," is right! 1580% increase in production since the War began is the latest report—happening within easy sight the plane spots set for 1942 and 1943.

That certainly is something to cheer about! To the men and women of the airplane industry, goes the applause and hearty thanks of every American. And, in turn, every plane plant every-

time and engineer gives thanks to the other American industries that are steadily supplying reliable materials with which to do the work.

With an ever-increasing demand as a token of quality and value, Valspar Valspar Aircraft Finishes are proud to have won a place among these "reliable materials with which to do the work."

**VALSPAR**  
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mechanisms starting as the lights come on fully at the turn of the switch as in incandescent lighting. Other features are used to include positive starting at lower atmospheric temperatures and lower voltage, no valve action failure and satisfactory tube life. Available in types for all applications, compressors or engine units, also available as expanded mounting, open reflector or inverted models.—Aviation, December, 1942.

**Tensile Strength Testers 58**  
Model B tensile testers, developed by W. B. Latham & Co., 6419 W. Harrison St., Chicago, are offered in portable table and floor units. Though



small in size, table model will physically shrink specimens up to 100 in. length, accommodate up to 9 in. width, and handle up to 25,000 lb. With provision of grips, special tests such as separational pull of sockets (table shows test of aircraft sockets) can be made. Dynamometer gives indicator permits wide limits of measurement with uniformly small stress-readings. Highest starts at 50 in. (table model) to 10 in. (floor type)—Aviation, December, 1942.

**Portable F-I Pump 59**  
Latest in line of "Pile Drivers" made by Edwards Engineering Co., 5761 Kalamazoo Bridge Ave., St. Louis, is "F-I" Series portable ferro-cement pump. This, static capacity, will pump setting compounds, mud, dredges, including material, heavy lubricant, etc., directly from ground containers to point of application. Portability of pump is feature.—Aviation, December, 1942.

### Torque Wrenches

Offering of complete line of torque wrenches affording wide range of application is announced by P. A. Stonebrink Co., Addison, Ill. Tools are designed for assembly and inspection purposes of torque applied when such strong critical screws and bolts and so on, require control, or longer service to predetermined torque. Eight models range in size and capacity from small instrument-building wrenches of very low inch-pound capacity to two-hand torque wrenches of 5,000-inch-pound capacity. All are of flat, tapered-head type with fixed end and tap ends.—Aviation, December, 1942.

### Hydraulic Test Bench

Portably hydraulic test bench for preflight checking of hydraulic control of planes has been brought out by Hydraulic Machinery, Inc., 10031 Grand River, Detroit. Testing includes putting valves through all hydraulic functions without running engine. Equipment consists of hydraulically operated air compressors (high or low pressure) for purpose of changing hydraulic accumulators. Can also be used



to pump hydraulic fluids in and out of planes, and, variable displacement pump permits test to operate hydraulic control at different speeds. Three or adjustable pressure range of 0 to 1,000 lb. per sq. in.—Aviation, December, 1942.

## Penco WOOD STORAGE EQUIPMENT

Aids Your War Production these ways...



### SHELVING

- Provides for increased floor space and storage of tools, parts and materials.
- Simplifies inventorying.
- Reduces losses and breakage.
- Saves time spent in locating items when for production purposes.



### LOCKERS

- Help maximize shop space.
- Provide for safe, dry storage of clothing and personal effects.
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### CABINETS

#### Tool and Storage

- Tool sorting and maintenance are clean and systematic.
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### ENGINEERED CONSTRUCTION—STANDARD SIZES AND SIZES

As the construction subsidiaries for Penco Steel Equipment, Penco Wood Lockers, Shelving and Cabinets will meet your current needs for adequate storage and systematic handling facilities. Write today for full information and prices.



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Come with us and see for yourself why Gardner-Denver "HA" Horizontal Two-Stage Air Compressors are helping to speed all out production.



**GREATER AIR CAPACITY**—Proven for heavy duty, maximum performance. Gardner-Denver "HA" compressors are supplying easy to use plant with as much as 200 cfm. They're built in capacities from 25 to 750 cfm, 50 displacement per min.



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**LOW CONSUMPTION REQUIREMENTS**—Operating costs are surprisingly low. For these compressors have been designed for unusually low horsepower requirements. Lubricated and oil-injected valves and port areas contribute to their extra efficiency.



**REMARKABLE MAINTENANCE RECORDS**—Our reports show that "HA" compressors need only an occasional service for low maintenance. Our operators report the "Air Custodian" valves need only require cleaning during 8 years of constant service.

Here are the suggested use air compressor rate and maintenance: 1. Keep valves clean—check all every 2 to 4 weeks. 2. Use only best grade of air compressor oil or cylinders. 3. Check valves are like at least once a week. 4. Test safety valves daily to prevent sticking. 5. Periodically inspect compressor valves—clean if necessary. 6. Check automatic water traps frequently to make certain they are operating.

For further information, write Gardner-Denver Company, Quincy, Illinois

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# HARDWICK, HINDLE

## BLUE RIBBON RESISTORS

PATENT PENDING

The maximum acceptance and widespread use of our Blue Ribbon Resistors exceeded our expectations. Designed on modern lines, compact, efficient and tough, they offer more than just higher wattage ratings for unit space required.

The resistance wire is accurately wound on a flexible core and the ends are lanced to terminate at any of our numerous types. Standard mounting is by means of an aluminum thimble which is in contact with the entire internal surface of the ceramic core. This thimble distributes heat uniformly along its entire length, eliminating hot spots normally found in tubular resistors with conventional mounting.

Our mounting rods are riveted to the ends of

the thimble, and tend to conduct heat to the mounting surface—they are designed also to spaces when two or more units are stacked. This resistor and its mounting form an integral unit. Blue Ribbon Resistors mount easily or loosely. They are easily mounted in a minimum of space. They are the best word in ceramic non-vitreous enamel construction and design.

Intermediate taps, adjustable contact heads, non-inductive winding, non-standard lengths and ratings.

There are important exclusive advantages in other types of resistors and rheostats made by us. Please consult us.

**HARDWICK, HINDLE, Inc.,**  
Newark, N. J., U. S. A.

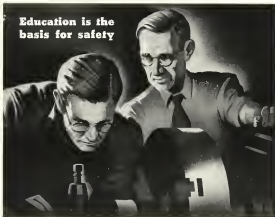
**ON LAND, SEA AND AIR**







## Education is the basis for safety



Information supplied by the National Safety Council

Leban, particularly inexperienced labor, cannot be expected to recognize the full penalties of carelessness in the shop. Management has assumed the responsibility of supervising safety measures, and has cooperated in establishing sound safety rules.

Nevertheless, the large increase in labor personnel due to war needs, plus the influx of inexperienced men, have resulted in a substantial increase in lost time accidents.

Even assuming that the obvious safety measures with regard to operating machinery, electrical equip-

ment and shop traffic have been installed, two factors—education and eternal vigilance—determine the real effectiveness of any safety program.

Both are the responsibility of the supervisory staff, team leaders up. The foreman who does a thorough job of educating his particular group in safety rules and cooperative enforcement has done much to cut down accidents. Management that takes an active interest in both safety education and the enforcement of safety measures has taken a great step forward in reducing wastage of irreplaceable production time.

CLIMAX FURNISHES AUTHENTICATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS: MOLYBDIC OXIDE—BRIGHTENED OR CANNELED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

**Climax Molybdenum Company**  
500 Fifth Avenue • New York City



thickness. No backing plates or liners are needed. Lead is indicated by 8-in. pressure dial. Cylinders, with 3-in. stroke, are set in lap position. This has overall height of 70 in. and total weight of approximately 800 lb.—*Aviation, December, 1942.*

### Plat's Seat 67

New plat's seat for military aircraft combining several new structural materials is announced by **Harold Corporation**, Los Angeles. Only metal parts are mounting brackets, shoulder ladders, and edgeing fittings. Plastic-impregnated fabric is used with special wood structure to produce seat

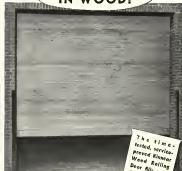


which is light, yet meeting all strength specifications. One basic type meets AN-1205 specifications for partial and full-time planes, another AN-8-2 requirements for long-range bombers. As yet, limited in pressure is used in fabricating, field repairs are simplified.—*Aviation, December, 1942.*

### Powder-Metal Parts 68

Latest development of **Bond Break Oil-Less Barring Co.**, Rosal Brook, N. J., is **Powderless**, powder metallurgy product, made into parts and bearings to meet new demand for savings on material and to eliminate need for machining. These are three distinct formulas of **Powderless**, with specifications providing pattern sizes when machining on tin and copper from 0 to 30 percent maximum, and it is adaptable to a wide variety of conditions and applications. Can be had either with or

You Want the Efficiency of  
Kinnear Steel Rolling Doors  
YOU CAN GET IT—  
IN WOOD!



The time-tested, service-proved Kinnear Wood Rolling Door fills war-time needs, but saves critical materials.

You can get the efficient, space-saving, saving ad-vantage of Kinnear Wood Rolling Doors in spite of war-time shortages—of Kinnear Wood Rolling Doors. Their durability and service has been thoroughly proved on numerous installations for many years.

Constructed of steel-plated wood slats joined with metal cables or tapes, they roll above the opening, instead of the way and out of reach of damage, require no outside frame, work as sliding doors for either interior or exterior. The rugged canvas assembly offers a high degree of protection, and blocks out wind and weather. Kinnear Wood Rolling Doors are available in any size, with motor, manual or mechanical operation. Write for Bulletin 10, containing complete details.



### ANOTHER KINNEAR WOOD DOOR FOR TODAY'S NEEDS

KINNEAR WOOD doors of any frame, fully tested under the most severe conditions, are now being used in many war-time applications. Available in any number of sizes, and being recommended for use in many other applications. Write for details.

THE KINNEAR MFG. CO.  
1440-65 Kells Ave. Columbus, Ohio

SAVING WAYS  
IN BOOKINGS

**KINNEAR**  
ROLLING DOORS

without lubricant impregnation with up to 25 percent oil content.—*Armstrong, December, 1942*

#### Screw Machine Tool 69

Known as Model B, screw machine tool now marketed by **Rogers-Schultz Corp.**, 2118 Mahan St., Chicago, is designed to take heavy cuts with less



torque. It has swiveling tool bit and specially adjusted index for easy adjustment. There is generous space for chips and coolant.—*Armstrong, December, 1942*

#### Plywood Lock-Nut 70

Self-locking speed nut for plywood assemblies is offered by **Tannerman Products, Inc.**, 38-50 Fulton Rd., Cleveland. With two pair of integrally formed slanting lips, it is designed for instant drawing into adjacent portion. Locknuts in 1/8-inch, 1/4-inch, 3/8-inch, 1/2-inch, 5/8-inch, and 3/4-inch sizes weighing only 25 to 300 and large bearing surface is stated to equal load even greater sizes. New



are made for use in both Air Corps 2264 and Air Corps 300-16 standard type "B" sheet metal screws.—*Armstrong, December, 1942*

#### Quick Action Vise 71

**Pacific Van Co.**, 8331 Hollywood Blvd., Los Angeles, Calif., has developed a quick action vise using a patented end and post which makes it possible to open and shut the vise like a drawer and lock it in any desired posi-

tion with but two turns of the handle. All working parts are of steel, precision machined, fully hardened and all parts are interchangeable. A new type novel base locking bar with two screw corner position lock in any position and equivalent shown. Adjustable in 4, 5 and 7-in. sizes with lock with and solid base types.—*Armstrong, December, 1942*

#### Non-Magnetic Bearings 72

NMI and NMD-magnet and NMD-great bearings are non-magnetic items bearing any offered by **Milliken Forster Bearings, Inc.**, 5711 E. 11th Ave., Denver. These bearings are manufactured of Herline No. 78, herline super alloy hardened, after machining, by heat treatment to approximately 40 Rockwell. Dimensions and tolerances are identical with SAE 52100 chrome steel bearings marketed by them.—*Armstrong, December, 1942*

#### Air-Ground Phone Unit 73

Introduced by **American Radio Hardware Co.**, 475 Broadway, New York, RM-141 phone unit is offered as a connecting-link unit between air



and ground communications. It is a double stream microphone unit designed for easy use by operator wearing heavy mask. Operating normally in open position, it can be locked into closed position for use in 400 m. overall, 4 m. thick, and 1 1/2 in. wide. Largest parts of bearing include microphone, lamps to take up cable stress.—*Armstrong, December, 1942*

#### Electrical Cable 74

Announcement comes of new series of **Auto-Lite** Sterling low tension approved electrical cable known as "B" Brand Synthetic. Approved under Army Navy Specification AN-AE-58 is made from 55 G.A., in 500 ft. cable in 1/4, 1/2, 3/4, 1, 1 1/2, 2, 3, 4, 5, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100 ft. lengths. Cable is made by **Auto-Lite Co.**, Post Office, Mich. Floor-mounted cordless composed used on cables in synthetic, protected



by special nylon head, with newly developed tongue with high abrasion resistance. Cable is small in size and low in weight.—*Armstrong, December, 1942*

#### Angle Drilling Heads 75

Specially applicable to aircraft assembly, and for work in close quarters primarily, are new **Wyco** angle drilling heads for use on double shaft or double shaft extension of portable electric drills. Designed as "Junior" size, they come with 90 deg., 45 deg., 30 deg., or universal handle and have overall dimensions of 4 or 4 1/2 in. Made by **Wycohead & Staff, Inc.**, 530 W. Hubbard St., Chicago.—*Armstrong, December, 1942*

#### Thick-Made Gaskets 76

Development of non-erect materials for certain gasket and stripping requirements is announced by **Tell Products Mfg. Co.**, 3030 Grand Ave., Chicago. **Tell-Pac** Thick-Made material, with sponge effect of rubber in weather resistant.—*Armstrong, December, 1942*

#### New Gas Tank Cap 77

Atwell provides tank cap monthly introduced by **Franklin & Nardone, Inc.**, Los Angeles, has double wings in critical moments, and through stamping process nature of former welding operations have been eliminated. In manufacture, sheet stock is drawn into tubular sections and has for locking cap to tank portion of assembly are automatically formed during stamping operation.—*Armstrong, December, 1942*



## UNSEEN BUT HEARD FROM

The planes that dropped devastation on these Jap warships were unseen, but their telling effect was very much there!

**Pesco** Pumps and related aircraft accessories are not in open view on the plane but their foremost performance is very much there!

**Pesco**  
Division of Borg-Warner  
Cleveland, Ohio

uses



# RBC NEEDLE BEARINGS

Mission accomplished . . . headed for home and a happy landing! When they're flitting with death above the clouds, the pilot and crew have at least the right to expect that their ship can be set down smoothly and safely. That's why the landing gear of Bombers are equipped with RBC Aircraft Bearings.



**ROLLER BEARING CO. of AMERICA**  
TRENTON . . . NEW JERSEY

AVIATION December 1942



**ELECTRIC DRILLS**—available from 10" to 1 1/2" including the famous **HOLGREN**—with wide choice of speeds, speeds and handle arrangements for every type of aircraft work.



**POWER DRIVERS**—used to drive everything from small screws to large nuts and bolts, clutch adjustments, engine heads and controls to drive all standard factory assemblies.



**ELECTRIC SHEARS**—speed up sheet metal cutting—either straight-line or in-blade pattern work, down to substantial cutting radius of 5/8". Cutting operation always visible. 2 sizes—16 and 18 gauge.

**GET IN THE SCRAP WITH YOUR SCRAP**



**ELECTRIC TAPPERS**—for hole threading at high speed with less tool breakage. Capable up to 5/8" in cut size, 1 1/2" in steel, 3/4" in brass or aluminum. Reverses automatically. Universal motor.



**ABRASIVE TOOLS**—Sanders, Portable Sanders and Bench Grinders—for smooth ing, cleaning, buffing, wire brushing and sharpening operations. . . . in metal, wood or plastics. Vast parts and special dies.

Where can you  
save **MORE** time with  
**MORE Black & Decker Tools?**

On aircraft parts, sub-assemblies and assemblies, on aircraft engines, equipment and armament, countless jobs are being done faster today—thanks to the advanced engineering and built-in quality of Black & Decker Portable Electric Tools.

A few of these tools are pictured here. Many more are shown in our new catalog. For a copy of the catalog—and as a dependable, convenient source of supply—phone your near-by Black & Decker Distributor. Or write to: The Black & Decker Mfg. Co., 1316 Pennsylvania Avenue, Towson, Maryland.



**Black & Decker**  
PORTABLE ELECTRIC TOOLS

# Connecticut SYNTHETIC RUBBER PARTS WITH SPECIAL PROPERTIES



**THE PROBLEM** Piece of synthetic rubber that requires certain properties has beyond AN or AMS standard specifications, is one of our specialties. We have handled many such assignments, in fact, a large part of our laboratory staff is constantly finding new ways to make synthetic rubber do things it never did before.

Each solution helps to meet the most problem—the accumulated knowledge is invaluable in this rapidly moving field. The answer to your problem may be already in our files.

We have the aviation industry's approach to development—chemical and engineering knowledge, a well equipped laboratory, and a willingness to try. Our production facilities also are geared to the speedy output of difficult pieces, with inspection and testing under strict control of the laboratory.

**WE** do not make stock parts—each job is custom made, each also from corresponding to field inspection is arranged to meet the conditions of actual operation.

If you have a piece that calls for special properties or design, and if it is important enough to the war effort, we will find a way to fit it into our laboratory schedule.

*The Connecticut  
Hard Rubber Company  
NEW HAVEN, CT*

## Boosting Bomber Production By Subcontracting

Glenn L. Martin Company reenters corps of 60 expeditors to work with parts and subassembly makers to speed flow of bombers to war fronts

By T. J. DUNNION, Director of Procurement, The Glenn L. Martin Company

A FEW MONTHS AGO a company in Baltimore was making war. Today it turns out small subassemblies for the Martin B-24, an attack bomber that has been giving Marshall Island plenty of trouble in Africa and over India.

Another concern in Indiana was making, of all things, riveted hair. Today it makes seat cushions for the mighty Martin B-24—"the bomber that broke the Japs' backs at Midway."

A Kansas Eastern producer, moreover, makes of many a costly hardware and finish, now done here making for the steady B-24. Martin built Navy patrol bomber.

There are a few typical examples of the way in which military factories—hundreds of them—are helping The Glenn L. Martin Company, one of bombers. Their cooperation has, in effect, added millions of feet of steel area and thousands upon thousands of skilled hands to the space and labor devoted to turning out Martin bombers. This is a notable percentage of the parts that go into our bombers are made by subcontractors. This is in addition to each government-owned enterprise in metal, properties and industry. It gives a tremendous lift and it helps get fighting planes to fighting men much more quickly than would otherwise be possible.

Here is a typical example of how such a method operation begins.

Six long ago the general manager of a firm in the Midwest called the Martin plant in St. Louis. He wanted to know how his firm could be helped to make an increase into a needed lot and he wondered if his factory could be used to us as an issue war.

He had an idea he could convert it into a shop to make wing spars for our bombers. Bombers need a lot of wing spars, so we were interested at once. A government engineer—we have 66 of them at large covering the country in search of just such opportunities—went to look over the place. He found its facilities suited to the making of wing spars but ideal for turning out exhaust stacks. Here! Today the milk can factory is furnishing exhaust stacks for each transport-the-Japs on the Mar to B-24.

This modest is neither unusual nor unique. Indeed, it is typical of the vast subcontracting experience which this company has built up since it started the industry in 1919 by appointing nearly 20 percent of the work.

as a single bomber type to other concerns by subcontractors. Today, under the terrible pressure of war production, that figure has nearly doubled and has been applied to three types of bombers now being built as a quantity production basis.

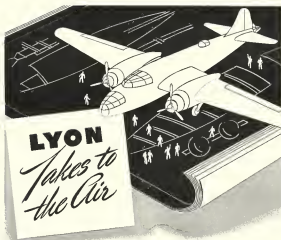
Martin's pre-war step of 1939 provided a good basis in subcontracting for the even more strenuous task that went to meet. Prices, fluctuated by orders of German war planes, turned—although too late—to the war. Martin immediately went to bat for doubling its plant size in 77 days and speeding its personnel by a rank-order training program. However, even this was not enough to keep ahead of the unheard-of demand for production of bombers, so the company hastily decided to find some means of enlarging the facilities and talents of other industries and plants, large and small, whose business had been curtailed by reason of priorities or other restrictions.

Service reports received the Scott located plants that could handle production jobs, showed them how and put them to work. The company's plan.

(Continued on page 38)



The steady Martin B-24 bomber, one of three types being built by Martin with the aid of subcontractors whose plants are located in their working from going to meet and up to the Capable efforts. Subcontractors account for nearly half of the component parts which make up the Martin assembly line in finished aircraft.



## New Producing Aircraft Parts in ALUMINUM as Well as STEEL

For more than two years Lyon's resources, facilities and organization have been concentrated on the production of war products. Careful research demonstrated that war experience in the fabrication of these metal made it possible to expand our war effort to include production of urgently needed aircraft parts.

Our new Aircraft Division... completely equipped, and supervised by foremen specially trained in aircraft plants... is now in production. First contracts cover components of *Alouettes*, *Buddies*, and *Elevators* in aluminum, plus Vertical Fin, Stabilizers, Elevators and Carburetor Intake Valves made of steel. Check list indicates the types of aircraft parts on which we can offer production help.

We invite your careful investigation of Lyon facilities for helping aircraft manufacturers increase their war production.

### LYON METAL PRODUCTS, INCORPORATED

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Branches and Distributors in All Principal Cities

## LYON METAL PRODUCTS, INCORPORATED

### ✓ Check LYON Facilities for Producing

- |                             |                      |
|-----------------------------|----------------------|
| ✓ 1 Wing Rips               | ✓ 8 Transport Cables |
| ✓ 2 Fin Welds               | ✓ 9 Service Lines    |
| ✓ 3 Bore-Cable and          | ✓ 10 Brackets        |
| ✓ 4 Bush Pins               | ✓ 11 Vertical Ribs   |
| ✓ 5 Covering                | ✓ 12 Insulators      |
| ✓ 6 "Cement" Pedestal       | ✓ 13 Air Valves      |
| ✓ 7 Wing Brackets, Brackets | ✓ 14 Flaps           |
| ✓ 8 Wing Ribs               | ✓ 15 Insulation Bars |
| ✓ 9 Wing Ribs               | ✓ 16 Insulation Ribs |
| ✓ 10 Wing Ribs              | ✓ 17 Insulation Ribs |
| ✓ 11 Wing Ribs              | ✓ 18 Insulation Ribs |

Our (Generalized) facilities, which are the best in the industry, are now in production. First contracts cover components of *Alouettes*, *Buddies*, and *Elevators* in aluminum, plus Vertical Fin, Stabilizers, Elevators and Carburetor Intake Valves made of steel. Check list indicates the types of aircraft parts on which we can offer production help.



carried staff still keeps in close touch with the war but outside concerns and is ready to get the alert in to the war effort. They help to set up an industry, rearrange factories, build materials and tools produced.

The result is that today any citizen, meeting anyone, knows a mighty lot of supply lines all over the country. Parts come to the main assembly plants from Cincinnati, Wisconsin, Ohio, Iowa, Minnesota from as far away as California.

Some of the changes in production that the war has brought would seem amazing if they were things that were to be done by the war effort. They help to set up an industry, rearrange factories, build materials and tools produced. The result is that today any citizen, meeting anyone, knows a mighty lot of supply lines all over the country. Parts come to the main assembly plants from Cincinnati, Wisconsin, Ohio, Iowa, Minnesota from as far away as California.

The conditions and efficiency with which the manufacturing services have been worked out, however, is possible without the day-and-night services of the company's staff of expeditors who manage the company from border to border and coast to coast. The life of an expeditor is not an easy one. The only shift this division ever known is getting quickly from one place to another, and it is more or less routine for them to spend most of their nights in airplanes or buses, which, under present conditions, is at best difficult.

Jimmy Zimmerman, our chief expeditor, tells of a case where out of his own mind he made a haul of steel in order to get in a Milwaukee plant so that, in addition to delivering the steel, he could deliver it right into the shops and get it into the machine.

Zimmerman also tells about the case when the steel company (Zimmerman) refused him and out of his own mind he made the morning to get him that the flight test would be held up on two pilotless balloons which were due for delivery in the morning, because a few specially designed balloons which had been promised had not arrived. Zimmerman immediately phoned the manufacturer, only to be advised instantly that one of his men was right there in the subcontractor's office, waiting for him to get dressed so that they could go to the plant and handle the parts through inspection. Two hours later the parts were being installed on the airplanes within two hours the balloons had been accepted by the Navy and were on their way to do their bit at some unknown front.

Not only do these men expedite parts and materials but they meet manufacturing with problems on tools, engineering and production. Here's a simple job they turned up:

Not many days before the Battle of Midway, we discovered that a certain machine part, made of aluminum, was not working as well as it should. It was decided to make the part of steel. It just happened that the factory best equipped to do the new job was in a Michigan city, a good distance from the main plant. My telephone call to the machine plant, by telephone we used the aluminum plant to send by fast truck the die needed to make the part. Meanwhile the plant selected for the job didn't have the steel to make the part. The Manager of the plant of the machine was asked to hold a place and wait to take off with 15 passengers. The passengers got out of the plane and were replaced by a truckload of steel rolled from our plant.

The die reached the Michigan plant at the same time the steel did and production was started immediately. Please



- Are you interested in:
- (1) Reducing time and cost of handling tools and materials;
  - (2) Saving floor space;
  - (3) Increasing production against fire, sabotage and personal injury hazards?

This comprehensive catalog contains many suggestions for meeting these war-time problems. It illustrates and describes many types and sizes of shop boxes, work benches, portable tool stands and many others that manufacturers of Airplanes and Airplane Parts are finding most effective in every production operation.

Mail coupon today for your copy of this useful book.

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Cooperation of large and small manufacturers has played a vital role in speeding production of the "War Machine" program. The Lyon Metal Products Company is currently making the country working force capable of producing aircraft parts and working with already established subcontractors to help meet steadily increasing production.



# Increase SPEED AND ACCURACY WITH SHEFFIELD PRECISION GAGING INSTRUMENTS



The Visual Gage is available in six magnification rates, 10x, 20x, 30x, 40x, 50x and 60x. It is for checking production and laboratory work in progress, inspecting and final gauging, laboratory and research work. Pitch diameter checked by special attachment.



The Horizontal is a combination gage which checks simultaneously a number of vertical dimensions, indicating by light signals whether each dimension is within, above or below tolerance limits. It is used for checking critical individual elements for readiness checking speed.



The Pendulum is available in gages for checking of internal diameters, taper and conicality on long and/or small bores such as rifle barrels and other relatively inaccessible holes. The gage may be positioned in the work, Model B, or in the work brought in the gage, Model E.



The Visual gage checks both diameter and tilt and with the same position on the work material, are checked on the Visual Gage. A very advantageous feature where tolerance centers is concerned is in the case of the special pitch gage application. Illustrated.



The Horizontal is designed for commonly designed holes which is dimensioned in width, tolerance, conicality or reverse. It is used as an inspection gage. It can also be mounted on any special fixture desired or directly on a machine to check parts in process or for machine control.



The Thread Gauging Instrument is a combination thread and measurement device for checking the lead of screw threads on work parts. Features gage blocks are used as a dimension standard. A Super Precision Measurement feature allows a mounted setup and the checking operation.

Descriptive literature available upon request

## THE SHEFFIELD CORPORATION

BATON, OHIO, U. S. A.



## FACTORIES FIND EXTRA VALUE IN SUSPENDED GAS HEATERS



AND now in the industrial field, Gas Heater Units have proved themselves outstanding. For their ability to deliver lots of warm air over wide areas is one of the reasons. But, delivering heat from a suspended position, above the working zone, also helps to make Gas Heater Units valuable to production management.

Gas Heater Units may be easily and quickly installed—with lower installation costs. This type heating equipment also uses 85% less fuel materials than cast radiator systems. You'll find it worthwhile to investigate. Write for catalog U-42.

### REZOR MFG. CO.

Box 29, Mount, Penn.



OUR HEATERS EXCLUSIVELY SOLD HERE

two of 6000 in. tolerance; three choppers, 8 800 in. tolerance; five saws, four lathes, one shaper and one turning machine plus grinding equipment. Also available are 37 portable air welders, three transformer type, three radiograph and three pantograph x-ray machines and five welding generators, for heating, carburizing and spray painting furnaces and two radiant room heat and plate shops here, among the heating machines, three bottle furnaces, five mill type, one hydrostatic finger mill, one steam roller; punching machines in three feet vertical angle and, two horizontal shafts and, three punch, two blanking three gang punches, one horizontal punching and, grinding and one double housing with punch, one shearing machines, including two armor plate shears, and three presses of from 50 to 200 tons.

132. Pennsylvania photo-engraving company prints complete reproduction, reducing or enlarging scale drawings or making photographic records for filing, offering the following equipment. Prices current \$1450 in 1000 work room, vacuum master frame, ruling machine, leveling machine and auto-etching machine.

133. New York firm, a merger of one which had been in aircraft maintenance and another and sales work for more than 10 years with one of 40-year experience to produce automotive machinery, auto subassemblies and offers the following equipment: Six 8000-in. tolerance engine lathes of from 40 to 50 in. swing, six precision lathes with 4 000-in. tolerance, two 8000 and one 8000-in. tolerance lathes with attachment; a turret lathe with millimeter thread chasing attachment; a power press, a screw machine; a gear shaper, eight drill presses, four saws; four grinders, two shapers; a planishing furnace, rolling equipment, leveling bench and measurement equipment.

135. Massachusetts machine and die development laboratory producing medical equipment, already equipped in electronic instrument subcontracting, auto subassembly work in the aircraft industry. Equipment includes: Riggs lathe; super drill press, gear and router saws, lathe lathe, grinding, engraving machine, tapping and drilling drill, auto lathe, 7 00000 cycles; oil-bath ray oscilloscope, electronic voltmeter; impedance bridge, test sets, meters, measurement machines, and 110-6 d.c. and 60-cycle a.c. generators.

**SMALL TOUGH JOBS.**

Typical work done produced on GG&T Hot Metal Stamper—small machine specially designed to produce a variety of light duty and cheap articles in subject in volume. Benefits range up to 95% savings in time. GG&T specializes in production of stamped discs and turned metal parts ranging from .001" to 1.00" round. Dimensions using all type metals and alloys. Reprints limited.

**GG&T**

**HEROLD STAMPINGS, Inc.**

Division of THE FIBER GOLF CO., INC.  
Midway, Franklin, Mass. 01912  
315 DEAN STREET, BOSTON, N. Y.

## SKILL and EXPERIENCE

SPECIALISTS in prefabricating and shaping sheet plywood from flat stock.

**PLYWOOD ANGLES  
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PLYWOOD TUBING**

**A CAPABLE ORGANIZATION**  
with ample capacity to meet your requirements promptly.

Send us your blueprints and specifications

WIRE OR WRITE TODAY.

**HERMSDORF**  
FIXTURE MFG. COMPANY  
MANCHESTER, N. H.  
**Plywood and Wood Parts**

# Hard-boiled babies

Adolf, here's your bomber—again. This hard-boiled baby helped sell your *Wheeler* at Dunkerque... and you the other night it was back blowing your pants, bounding your stopping.

Herman... it's that Hudson your *Left* wife has never really stopped... she says she's a *T* calls. Old boomerang—because it always comes back.

Hudson: You've started Lockheed too, and he'll keep on coming in—lots of plans, and things like that. For the Hudson was only doing a job, it wasn't even close for itself.

And, boys, we got a big bomber, the *Vega* version, that has all the family characteristics, and some new tricks of its own. Lockheed Aircraft Corporation... Vega Aircraft Corporation... B-24's, C-47's.

For protection today, and progress tomorrow, look to

## Lockheed

FOR LEADERSHIP



HERE'S SOMETHING TO HELP YOU

## Clear the Air



### HANDBOOK OF SPECIAL STEELS

Heavily revised and completely up-to-date, this handbook is the most comprehensive source of information on the properties, uses, and heat treatment of special steels. It includes a complete list of special steels, their properties, and their uses. It is a must-have for all engineers, metallurgists, and designers.

### ELEMENTARY DISCUSSIONS: TOOL AND STAINLESS STEELS

This pamphlet introduces young engineers to the properties, uses, and heat treatment of tool and stainless steels. It includes a complete list of tool and stainless steels, their properties, and their uses. It is a must-have for all engineers, metallurgists, and designers.



THE lack of information can slow a pretty effective work-around around jobs on the production line. After all, it's about the same as on the front line—you can't hit them if you can't see them.

Your plant is probably no exception to the general run of war producers. All have a steady job on their hands of training a stream of new men and apprentices in specialized machine operation or other fabricating procedures. Where this needed information concerns alloy steels, you'll find invaluable the publications listed in the panel to the left.

They're primarily for production men. For engineers and designers, complete and detailed technical

data on the various types of alloys and tool steels is available in Allegheny Ludlum "Blue Sheets."

Write for the information of the personnel knowledge you need.



## Allegheny Ludlum STEEL CORPORATION

CHICAGO, ILLINOIS • PITTSBURGH, PENNSYLVANIA

Illustration: Kenneth W. P. Pictures (Curtis)



# Yes, THE HELICOPTERS ARE COMING



THAT'S a fact which has just been brought home to the American public by Igor Sikorsky's recent article in *The Atlantic Monthly*, reprinted in *Reader's Digest*, and by the Sikorsky helicopter pictures in a recent issue of *Life*.

But it wasn't news to Aircooled Motors Corporation, whose Franklin engine powered the original Sikorsky experimental helicopter during its development period.

Whether it's a stock engine for a light plane, power for a helicopter, or designing and building warplane engines for Uncle Sam's Army and Navy (our current job) ... you can depend on Franklin's 42 years of air-cooled experience to produce fine engines.

**AIRCOOLED MOTORS CORPORATION, SYRACUSE, N. Y.**



**AS GIFTS OF PEACE GIVE WAY TO WAR**

## Relays BY GUARDIAN ... SERVE ALL FRONTS!

★ Yearlike jobs of '42 will not include the many electrical gifts which brought on sleep, and ease, and comfort in other years. Relays by Guardian have marched on from peacetime industry to the front lines of war. Doing war jobs in many ways ... in planes ... in tanks ... in communications ... in bomb releases and gun controls. Warlike jobs which Guardian anticipated and planned long before "Pearl Harbor".



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tives and advertising buyers, the correlation section of the booklet shows clearly how Aviation's circulation thoroughly covers the industry's buying power. How it is directed to the men you must sell, the executives who have the pre-war or in purchasing decisions a aviation's manufacturing, operating and maintenance divisions - and that important group - the government and military authorities concerned with aviation activities.

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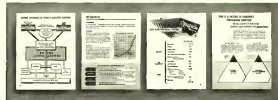


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*Illustration by John J. Allen*

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That day will find Bell Aircraft ready—ready with its engineering skill, assembly lines and trained personnel converted to the pursuits of peace time aviation. © Bell Aircraft Corporation, Buffalo, New York.

*Airacobras for victory—*  
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J. Am. Stat. Assoc. 1998, Vol. 93

*Journal of Advanced Training*

**ARMY AND NAVY** HEROES OF THE AIR

Curtis Wright fighters, dive-bombers, observation and military cargo airplanes are conspicuous constants in the war's headlines. But behind these headlines is another type of Curtis Wright doc—the trainer—in which

thousands of America's superb fighter pilots today are wearing their wings. Twenty-five years of development lie behind these modern training planes — for the world's earliest trainers were the famous "Jennys" of World War I.

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**1996:** First Census Block 2.7 in July and all Trunks in 1996 H.P. Census year also ship a high speed 100 in p.h. connection over a 1.500 m. s. b.

**9929:** The Curran Key Hydro-  
lane primary tunnel (N20-E)  
Shall extend 110 m in h. cross-  
ing 37 m p. h. Fenced with a  
Wooded 1.5 km.

**79400 • The Cytoskeletal Protein**  
**2017-40**—a letter, limited to a  
 total count of 100 or less, and  
 a space allowed of 100 or less.

\* THE BUNSTER dollies an ode to a 'fine piece of rustic style and long, soft of curved in arched back'.

Even though he grants the leverage of "voiced to singular notes," this dependent staff can't write a three-part. But if it were possible, this 12-21 would be titled "Ode to the PHE." And it would tell one of the most heart wrenching tales yet to come out of this rift of the classroom and credibility of American sci-

costs and the uncertainty, and 10% of American income. Inclusion would turn a PNY tax into a parallel or a combination drive and hyperinflation, leaving out of the bill of Korea to work in days from transport of a covered here in the defense of the defense.

For example, this rule would release from the PBY was destroyed and had to be back in the air. The rule is a large range period longer. It should tell of the environment created when a person is

Many waterfowl, including waterfowl groups as diverse as King eiders, come from the West Coast to their lakes in Hungary, and later from the West Coast to the Pannonic Coastal Zone, an even more heavily irrigated area. Such differences were felt in those days even though the Saxs always called them common ducks.

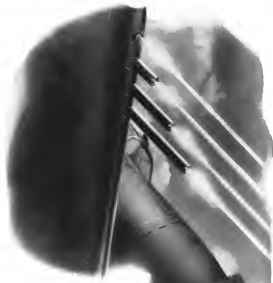
• It would never hurt, that a PITT—called the *Londoner* by the British—found and stalked the Diamond, pride of the New York Times. That was work for which the PITT had been bred—spotting the catfish and keeping him under surveillance; till, certain, sure, could be released: all, the, fish.

Designing would not be avoided, but the rule would tell off the long-standing lumber "BET" and then would put us on our frequent work. No longer, no waste in business—and not back to work that is, very a large part of way, but indeed which is a significant part of the way.

to become tied as long and grueling as transatlantic, backing the money first units. And here, when top officers with their minds, fighters were spotted, the PW crews would notice the location and add immediately, "back to work at the" because that, were there in step and right as long as that, could



<sup>11</sup> However, wouldn't you be providing order for a gun store sale?



**WHEN A THUNDERBOLT STRIKES** Eight deadly streams of steel-jacketed metal apart from the wing batteries of a Sopwith P-47 Thunderbolt with an impact guaranteed to tear apart any Swastika'd Jfan or ruddy Rising Sun that dare fly within range.

# REPUBLIC AVIATION

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FARMINGDALE, L. I., NEW YORK

## How Our Navy Gears Pilots For War

In revolutionary four-phase system, each cadet gets solid year of training, amasses nearly 300 hours. Meantime, Navy's new scientific methods have brought "bigs outs" down to an all-time low.

By LIEUT. (jg.)  
FRED TUPPER, JR.

FROM CORAL SEA to Midway, from the Aleutians to off Santa Son, every dogfight, landing attack, and pinned moment is giving a new heavy stamp on the thousand recruitments of aerial war pilots. And aviation, while almost entirely thrust through the unrelenting "Mediterranean" and waters across the Pacific to change their tactics of planes, our Navy is also multiplying its own efforts ashore.

To pilot bombers and scouts, fighters and pinned planes are rolling in over in training quarters from shipping assembly lines. Dozens of recruits—counting the recruited reinforcements—are being trained for action. Land-based fighters are joining the aerial war.

To keep pace, a vast new cadre of Navy pilots—32,000 strong—is being trained at air bases from 12 miles to the Gulf. While it stands to do it. Any young man between 18 and 21 who has a high school diploma (the two years of college equivalent is now "real") can "test it" if he is physically fit and can pass a "survival" test. To prepare for war, the Navy has introduced a revolutionary new type of training program designed not only to produce the best pilots in the world but to make them physically tough, mentally alert, and completely ready for any emergency of land or sea warfare.

It takes a lot of doing, and here's how the Navy is approaching the problem. Each cadet will get a solid year of

training. The Navy will spend up to \$15,000 on him personally, all aviation that he'll get nearly 300 flying hours under his safety belt before he joins the fleet.

Training is split up into four phases, each of approximately three months duration. First, the cadet will attend a pre-flight school (each one is an "Academy of the Air") at one of four campuses—at Athens, Ga., Chapel Hill, N.C., Iowa City, Iowa, or St. Mary's, Calif. Then, at one of a score of strategically situated naval aviation bases, he will learn to fly in primary trainers.

Next step is advanced training at one of the large naval aviation centers, at Corpus Christi, Tex., or Pensacola, Fla. And finally, concentrated on missions in the Naval Reserve or a second assignment at the Marine Corps, each pilot will have a course in operational training as combat or patrol craft, he four being assigned to active duty.

In cases where three applicants at Naval Cadet School in Annapolis cannot be sent immediately to pre-flight schools, there is now additional preliminary training. The Navy has arranged with the CAA for 10-week full time and 16-

Our report reads: "Without pilot training beyond the school life. Twelve full months of crash training have been awarded in this system by the Navy to make him the 'right man at the right place'—and even for a self-the training, his ability, and his luck."

Illustration: (left) Pilot in flight; (right) Pilot in flight.





Abstract: *Polystyrene* and *poly(methyl methacrylate)* (PMMA) are common polymers used in many applications. They are both known to be susceptible to degradation by ultraviolet (UV) radiation. This study investigates the effect of UV radiation on the mechanical properties of these polymers. The results show that the tensile strength and elongation at break of both polymers decrease significantly after exposure to UV radiation. The degradation is more pronounced in PMMA than in polystyrene. The study also shows that the degradation is more pronounced in the presence of oxygen. The results suggest that UV radiation can be used as a method for degrading these polymers.

Many thousands of the product have been found to date and today 30,000 more Navy stores are being carefully guarded at our bases from Canada to the Gulf—to multiply these stores into a vicious armada.



work entire curricular CPT courses for Naval Reserve training. The CAA plans to train more than 20,000 of these men annually under the new set-up.

With such preliminaries, the robot will represent a much better investment than a potential pilot. He will have an opportunity, long before he flies a Navy plane, to find out whether he has any aptitude for flying. He will be physically and mentally prepared for the rigors of modern warfare.

Attrition loss has been the cause of

pilot training. As recently as two years ago, trainee salaries cost the Navy more than \$3,000 for each cadet. However, with the introduction of CPT and pre-

Many Frier has a specialized task

most all its own. To be sure, differences

Below, Michael's skill may be assessed by another pilot following completion of his solo.

time. To tell comparatively cheap another day as rest appears of some with her must put the magazine, and to get along down as our own that day demands better: examined at place. Perspectives in accompanying photo of Douglas does better than it could: quickly inflicts afflictions of both audiences.

[illegible]

from Army aviation are where he has the primary flying training. Both the Army and Navy use the biplane (painted yellow in both services) almost universally, for the "biplane" is considered the soundest training machine for fundamentals. And both services stress the early drills in turning, tail-down landings, coordinated air work, and simulated emergency

However, while the Navy uses the diagonal pattern for promotion bands, the Army views the triangular ... the Navy does wargivers without pattern, the Army treats the most as a figured ... the Navy goes three shorts before solo, the Army shows a cadet to take a phase out after his instruction given last thumbs up. Still, the event and result is the same—the cadets leave every trail in the finger book.

But the Navy points its finger in a completely different direction. To integrate all a carrier's warship, to provide for a carrier deck landing, is a space and 80 ft scale, is being a single deck in a previous landing is a "chick"—these premises have no parallel in Army or civilian flying.

fully, he runs the gamut of emotions here. He learns how to 'dry' into a lightning, how to do floppy tummy, magnifying, spirals, and how to 'shoot' 100 ft. under. Scuba-dived teenagers are pervasive during prisoner instruction. The central mind reader snail-fart parades, and there is the best example

Advantage: All these will pass, the students being on

These students literally "got the water." A 1990s 3-hour coffee seminar was more like this. But, best was

roll to the right and left, rotate. Inward-rotation, split 90 and taking knees. They leave previous open and half it turns to reverse, and finally, there are demonstrations of the reversed open and the reverse, implied legwork of previous thing. From that they move off from the front seat, then progress to intermediate: turning at Corpus and Penicula.

By this time each outlet has had up to 50 hours in the air. Now he has the job moved further—the SGL's latest service-type phone, and he means more business work.

that the picture is not complete without general school. Throughout the course, adults receive education in general school curriculum, the single, because about plans from prep to test. There are desks in penitentiaries, photographs, games, studies, situations, meetings, and communication, more or less in that order—a comprehensive state of knowledge that could be considered complete.

Each week until Labor Day he put an engine together, to fire as machines go—then analyze a weather report, and to map his course by the stars. Knappton being the daily drink of modern sailors, a Navy pilot must be the "light man in the night place!" For more he takes off from a carrier, he's strictly an Air Corps.

At this advanced-training stage of his development, the subject is granted the opportunity of expressing the type of data he would prefer when he is assigned to the field. He may, thus, ask for a specific geographic habitat, depend upon upon his destiny. Whenever possible, these wishes are considered.

"Shore life in Japan," read one of our small. The woman the Swiss

quickly replied: "The amended appeal—no, you get a short time to establish that there's."

What finally happens is that A student is given one of three assignments on a certain day, which means firing different reading plans, or else and perhaps leaders. . . . Building on various days, which involves firing various plans and using the "one of the three" . . . or paired days as the paired firing leads, which reorganizes themselves at rates of one

Cavalier (more than): The day will come—sometime, somewhere at sea—when today's rebel will lead the brave new order. "Glad you played?" He will run down the deck and take off now, enough

on an experimental point. But looking from different -but- outside. In the first place, looking at floating towers upon others from a little constant side for a special technique is itself, based on thorough mathematics training and strong experience. To wit, place them on the wrong, individual surface is comparable to looking on a dome.

lance' technique. Returning from a patrol mission on the Canal Zone, says, "I was stopped by three men on an American main deck. And aircraft blew us back toward the water."

To Navy pilots, takeoffs and landings are like human games, at the aircraft position at flying a course based plane. They must learn the procedures at takeoff and landing, including climb, descent, approach, coordination of plane position, and methods of attack. They must learn tactics and parallel duties for fighters and bombers. Navy pilots currently learned any more American line work, such as maneuvers in water and the opposite for land and Navy.

One of the fastest operations known to natural systems is that of a fish leaping to crosser. That means *skipfish*. Skipfish must be held all the way back on skis, so the launching force builds to the maximum from a fixed starting point to insure that a 100 mph speed before one can get "backwards."

Landings in the water must be fully controlled, groups—no "shut-in" leaving ones. These are previous landings—plus! The complete wait, for the bathing day, as courses in time, then sets down on the sun-dried water ready for the sun (the "shut-in" enough in the time to permit a "rest" measure). If there, frankly—on also. The shut hasn't time to wait for planes that now. You can the planes themselves get off the

A gutted bucket, again, is still an idea loved at 1st. And a log age. These random bath-tubs of the air, painted with faces two to four inches, are capable of firing good old-fashioned rain. As direct as the air, the rain, they even have heads of lizards, birds, and mice. They are "the one bucket," complete with heads.

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Right Passage: New performance! Sweet Jap. Splines were chosen by Lead. (pg) John & Luggie. (GAB) (Jab) and ARM. In John Under. (GAB) Lead Luggie got here. John three.

Excess of interest from the "money market" is fed forward to debt collectors (which call toll) and can also collect. These advanced students preparing for leadership or major debts, are "bumped" by course or split across of their training at People's Academy GSD-2 (some would call it a "bump").

\_\_\_\_\_



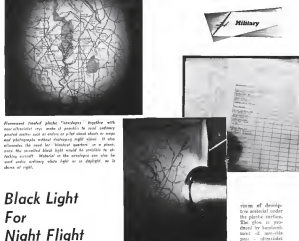
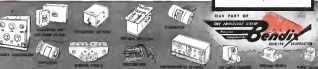
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RADIO ACCESSORIES



The long arm of the allied airmen continues to reach out and apex the enemy with deadly accuracy. The Himek, the Jap advance on Midway, the operations in the Aleutians, and other unheralded tip-offs are to the credit of Consolidated FBY Catalina flown by U. S., British, Dutch and Australian airmen.

Flying aboard ships like these are products of this company which go to make up the great Invisible Crew. Such accessories by Bendix Aviation, Ltd., are at the front on virtually all American aircraft.

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### Black Light For Night Flight

Near-ultraviolet ray unit designed to protect night adaptation of bomber crews with flexibility essential to efficient operation.

THE PROBLEM OF MAINTAINING  
high quality of lumber prices, while still

quantities, time to seed and seed weight and/or fruit shape, morphology or other potential maternal effects besides the selection through new developments in coexistence, non-allelic control, etc. and flowering/fruit/transport phenology at the end of the spectrum.

In operation the unit produces a low intensity of moon and star light directed over an image of the human and trivial transparent plastic, with a minimum light glow sufficient to

The Gordon portable unit, composed of a unit mounted on a non-tiltable stand at the 4-in. 24.25-in. black light source standardized in back the Amer. and Navy also placed 1 in. above the fluorescent surface will permit viewing in a 36-in. area.

The 'reimagines' originated by the GSA process may be used either to illustrate small-scale table-top charts, reduce photographs or maps or provided as overlays on 4:1 million charts, or they may be used alone for vector projections for use in the GSA process. Provisions for use of the GSA process have been designed into a new basemap, production for which is under way, and are currently being used by the State Corps. The overlays can be made up in practically any size desired—large small-scale tables through standard letter-size up to any size chart cover and are suitable for reproduction.

AVIATION December 1941







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The impact of war makes more essential than ever day-to-day analysis by competent men. Recently, Congress has reduced some taxes, raised others. Price controls and income ceilings are now low. To do the utmost to safeguard capital and savings from possible inflation and taxes, the service of experts who make the protection of savings their full-time job is required.

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# Aviation's Future Trends

By SELIG ALTSCHUL

AIR TRANSPORT EQUITIES have reached an historic popularity recently. This is partly a reflection of the sustained volume operations being experienced by the airlines and the expectation that record earnings will be established this year. The greater impetus to rising prices for airline stocks, however, is found in the dramatic programs which have been so popularly associated with the industry's future.

Encouraging the electrician's outlook, it appears fairly certain by now that the domestic air services will be able to meet as much if not more consumer demand by 1947 than they did a year ago—despite operating with almost unrelenting the number of planes the greater part of the year as were formerly available.

Revised and heavy reliance on all departments—passenger, mail, and express—prompted extensive utilization of available equipment and made for profitable operations. Savings have been further enhanced by the elimination of the special demands on ramp and runways. "Other means" that can work will also be a major factor in 1947 earnings reports. In the aggregate, it seems reasonable to expect, in the absence of complete interest reports due to military, counter ship, that the domestic air services will exceed 1945's net earnings of about

\$100,000 by a wide margin and even pass the previous record profits of \$6,150,000 shown for 1946.

## Future Being Discounted

It is more than record earnings, however, which are responsible for the transport services establishment now being the year and displaying the first serious pessimism among the various groups. (These encompassing earnings and chart.) Many investors and speculators are trying to peer beyond the present and picture, in a somewhat optimistic, or commercial position in the postwar period.

There can be no denying that the airlines will experience a major growth trend and adjust to an economic, in general, as volume of business. However, considering the volume to net earnings means to be seen.

The new buying of the electric power industry clearly reveals that a substantial reserve in volume operations does not necessarily carry through to an increase. The electric utilities are highly susceptible to the whims. Strong growth trends and characteristics of the two groups. Both industries are controlled by a heavy public interest and are regulated by federal agencies.

According to the Federal Power Commission, the output of electric power was more than doubled from 525 billion kwh in 1932 to 104 billion kwh in 1941. At the same time, a comparison of virtually all of the country's elec-

tric utility companies shows that average available for 1941 doubled amounted to about \$17,000,000 in 1942 and declined to \$10,000,000 in 1941. In other words, during this two-year period, while volume more than doubled, net earnings actually declined.

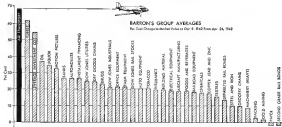
Why this decline in profits in the face of such a substantial gain in volume? Is a true index operating units and increased losses, lower profits, but the major elements responsible were the increased reduction in price charged for the electric power.

(Continued on page 224)

TABLE 1.—NET WORTH AND RETURN ON CAPITAL

Air Major Airlines	1941		1942		1943	
	Net Worth	Return	Net Worth	Return	Net Worth	Return
American	\$1,100,000,000	10.0%	\$1,100,000,000	10.0%	\$1,100,000,000	10.0%
Eastern	\$1,100,000,000	10.0%	\$1,100,000,000	10.0%	\$1,100,000,000	10.0%
Northwest	\$1,100,000,000	10.0%	\$1,100,000,000	10.0%	\$1,100,000,000	10.0%
Transcontinental	\$1,100,000,000	10.0%	\$1,100,000,000	10.0%	\$1,100,000,000	10.0%
United	\$1,100,000,000	10.0%	\$1,100,000,000	10.0%	\$1,100,000,000	10.0%

BARRON'S STOCK AVERAGES			
Year	1941	1942	1943
Industrial	100.0	100.0	100.0
Transportation	100.0	100.0	100.0
Utilities	100.0	100.0	100.0
Chemicals	100.0	100.0	100.0
Metals	100.0	100.0	100.0
Textiles	100.0	100.0	100.0
Food	100.0	100.0	100.0
Pharmaceuticals	100.0	100.0	100.0
Oil	100.0	100.0	100.0
Real Estate	100.0	100.0	100.0
Government	100.0	100.0	100.0
Foreign	100.0	100.0	100.0
High Grade	100.0	100.0	100.0



Note: Data for 1943 and up to Dec. 31, 1943, are preliminary figures and have been made by the air transport group.

# CIVIL AIR PATROL COMPLETES YEAR OF SERVICE

Volunteer "Flying Minute Men" aid Army and Navy on coastal submarine patrol; civilian organization expanding courier service with private planes.

By MAJ. EARLE L. JOHNSON, National Commander

ONLY A YEAR AGO, Civil Air Patrol came into being through the fusion of the mail service of the country, as the first civilian unit, to be utilized with their equipment in the war effort. From its formation a week before Pearl Harbor and from the first meeting of the 40 Wing Commanders, leaders to drop what they were doing and pitch in to

get their national mission. America's first of public-private planes has had a wide variety of work to do on a non-stop, around-the-clock basis.

Today, the Wings of Civil Air Patrol in every state, without exception, are better equipped and more active than at any time since the beginning. Under the Wing Commanders, more than

45,000 active volunteers have enrolled in the Squads and Flights at more than 3,000 airports in all parts of the country.

The first period of CAP development was one of organization and training to band together the private pilots, who live before as individuals, into hard-driving units, ready for any type of mission while light planes are capable of flight. The second step was to set up a series of CAP Coastal Patrols, to men and equip them as a volunteer force, on standing watch for enemy submarines along our shores. The third phase, now well advanced, is to develop relief missions, in that qualified flyers in every area may be able to speed up work time as they can devote to the

do at first birthday the Civil Air Patrol boasts more than 45,000 members organized into Squads and Flights at more than 3,000 airports throughout the country. Military draft is a fundamental part of all the

training in a class by their typical Squadron. More part of the personnel and equipment of the Howard Wing, Squads and Flights, and at Lambert St. Louis Field about operations.



## Patrol on world weather mission

At the beginning, each local unit stood on its own legs, guard, flying and practicing for the attack all hoped would never come. Most of the State Guard aviation units were disbanded and merged with the Patrol because of the greater flexibility of the national organization in performing missions regardless of state lines. Close cooperation had been maintained with the ground services in the states and with the protective units of the Office of Civilian Defense, of which CAP is a division.

But the Patrol soon had the good fortune to be assigned also to other missions for which men and planes were detached from their local Squads for service at CAP coastal bases and courier stations. Thousands of members who were in a position to volunteer 30 days or more continuously serve as a job have gone on CAP service duty and many more are waiting their turn. The nationwide character of the Patrol is indicated by the fact that members from more than 40 states are now on active assignments.

The rapid expansion work is in the Coastal Patrol which began to operate early in the year when the Air was taking heavy toll of American tankers and merchant vessels on the vital supply routes along our shores. In the words of Major Gen. Robert Bradford, then "Flying Minute Men" brought their own planes, repair tools, radios, and other equipment in its make ready for emergency like well equipped land-based units. Submarines spotted by CAP have been sunk. Gen. Bradford revealed others about to attack vessels have been directed on the approach at CAP planes. Vessels in distress have been reported and hundreds of survivors of torpedoes have been located for rescue by surface vessels.

This work is done under the command of CAP's own volunteer officers under the general supervision of the Army Air Forces. Most of the men are suitable for military service. Many

## Civil Operation and Training



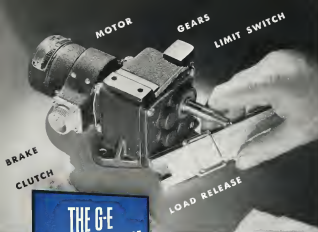
Coastal patrol in which CAP's members from Army and Navy pilots and planes for other work, a lot of the most important of the year-old civilian organization's duties. Many of the members serving on patrol stations or ground divisions have completely given up their previous line of business to go on active duty "for the duration." Here is an operations office of a few members on the East Coast where both men and women members from the West Wing take their turn of duty.



ABOVE: Civil Air Patrol pilots have added both civilian defense groups and the ground forces in many ways. As well as using private planes, they have organized and equipped themselves to help in the defense of the nation, while Army Air Forces have and CAP pilots and planes for courier service.

LEFT: Some important divisions have been built of men and women and have been built by the Wings Wing which recently delivered its own report, "Wings Field," built by CAP members themselves.





**THE G-E  
POWER PACKAGE**  
*For Aircraft*

**A Complete Unit...  
In One Package... Shipped  
Assembled... Ready to Install**



**Wing flap operating power package**—consists of self-contained wound motor with special clutch.



**Power package for operating control and protective devices**—consists of motor and gear reduction.

**To simplify plane design and save manufacturing man-hours.** All the required devices to do a complete job are built as one compact, light-weight unit—ready for installation on the plane. The designer who uses a G-E "power package" simplifies his job, and gets it done because he is relieved of coordinating a complete sub-assembly. He also gains space, because this complete unit is designed compactly to meet limited space requirements. Skilled man-hours on the assembly floor are saved, because the power package eliminates sub-assembly time.

**And "odd man's lightness."** The G-E power package is lighter than several separate devices that perform the same function. And, being electric, it is operated from an electric power source, which is inherently light in weight, and which can be in duplicate for added reliability in combat. This saves overall weight as compared with other systems offering comparable reliability.

Each power package is fitted to the specific job it is to perform. G-E engineers coordinate the motor, gears, control, or other elements required.

When you have a new design under consideration, see the nearest G-E office about obtaining sample power packages for test. Although General Electric factories are now working at full tilt to satisfy the demand for aircraft motors, we will be glad to work with you on the design of equipment for new planes, and to discuss the production requirements such new equipment will involve. General Electric, Schenectady, N. Y.

#### G-E POWER PACKAGE



**SEVERAL FUNCTIONS—ONE UNIT**  
Including  
Motor  
Brake  
Gears  
Clutch  
Limit Switch  
Load Release



**Leading gear operating power package**—consists of motor with built-in magnetor linkage, high-efficiency gear reduction, clutch clutch on output shaft, and shock extension for manual operation.

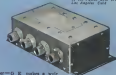


**Bomb-thrower operating power package**—consists of motor, high-efficiency gear reduction, with a special clutch on output shaft.



**Wing flap operating power package**—consists of motor, magnetor linkage, high-efficiency gear reduction, and clutch.

Draw for the above units and information to the Pacific Air Works, Los Angeles, Calif.



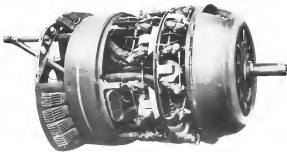
**And remember—G-E makes a wide variety of plane equipment.** For example, the battery and instrument (alternator) for instrument lighting of instruments. With capacity from 4-watt lamp and providing 1 volt, 30 amp power for indicator and dim lights. Weighs only 1 lb. 10 oz. G-E makes magnetos, generators, voltage regulators, radio current coils, dynamometers, magneto, instruments, radio equipment, and a variety of wire, cables, and switches.

**GENERAL ELECTRIC**

The BMW 801A as installed in the Dornier 212 is a complete and compact power unit—only 1,600 lbs. at 2,000 rpm at 14,250 ft. making it the lightest powered Dornier aircraft motor yet put in competitive production. The 801—rated to develop some 2,000 hp—has only recently been reported to be coming off assembly lines in sizable quantities. But while the 801 is a compact unit, it is far from

a maintenance man's dream for accessibility has been sacrificed to a large degree. Apparently the Dornier designers have believed beyond the point of replacing the entire engine. The removal of the five engine mount bolts seems to disassemble the whole paraphernalia except for fuel lines and engine mounting substantially.

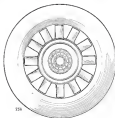
See text on opposite "Flyer"



## Design Details of the BMW-801A Engine

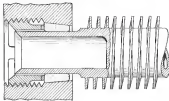
Second part of a first-hand study by an "Aviation" correspondent, showing additional construction features of a leading German aircooled powerplant.

By MYLES V. CAVE, Aviation's British Correspondent

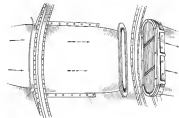
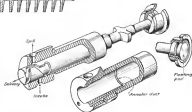


The extremely close-fitting cooling and the fuel distribution vanes are located within the cooling fins. Incorporated within the cooling fins forming at 172 a crankshaft speed (about) and behind the 110° three-bladed propeller which runs at 610 a crankshaft speed. From the fan drive gear is taken the drive for the two Bosch ZM 14 magneto, both of which are mounted vertically on the aluminum alloy fuel case.

Old valveless valves are sealed by the simple process shown here. The threaded and fitting screws drive into a taper sleeve to make a lockproof joint by pushing the tube.



The fuel injection pump for the BMW-801 is the first multi-stage high pressure pump built for production or tested from end to end, requiring the injection system is similar in design to the laster fuel pump. Each plunger head is initially cut and ground to provide a suitable angle from the tip, which and which points in the sleeve to allow for varying flexible conditions.



The detail sketch shows one of the supercharger vanes which cut within the cooling fins. The photograph opposite the right hand valve can be seen clearly behind the right-hand cylinder and fuel is fed to the rear portion of the cooling. A similar valve is set in a corresponding position on the opposite side. The supercharger operates at 825 a crankshaft speed in low gear and 746 a crankshaft speed in high gear.

(Continued on page 158)



## from BLUEPRINT to BATTLE PLAN

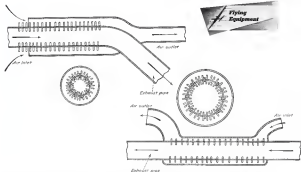
**B**REEZE Radio Ignition Shielding is being produced today in ever-increasing quantities for the fighting forces of the United Nations on land, on the sea, and in the air. Designed for use on hundreds of different types of engines, this shielding has been developed and perfected by Breeze over a

period of many years. Through its wide background of experience, Breeze has acquired unequalled know-how in solving shielding problems, from blueprint stages to actual performance on the world's battlefields.

Radio Ignition Shielding reflects the high quality of Breeze standards in design and manufacturing.



BREEZE CORPORATIONS, INC. • NEWARK, NEW JERSEY



Both wing shielding and radio shielding are taken care of through utilization of exhaust lead by a system based on American research of about 15 years ago. At top is shown the arrangement for taking lead off for shielding of wings and fuselage's compartment. Above is the exhaust pipe for leading the main intake of the D-202. (See AVIATION, November, 1942, page 128.)

The engine cooling has two pre-installed rings for cooling adjustment, one located in the nose and one behind the rear cylinders. The oil radiator is located just behind the nose ring, the cooling air being forced in by the fan and its flow directed to go through the radiator and out around the cooling in the back. The 190 fighter plane installation the rear adjustable ring is shown.



1. Plan of Exhaust Box



2. Elevation of Exhaust Box

Exhaust flame damping is accomplished with what appears to be exceptionally short stacks which, as may be seen in the photo on page 216, are placed at the tip of the engine and before the main intake on each side. In reality, however, the exhaust pipes have considerable length since they are inside the cooling wall back of the engine; the only exposed part being the flame damping stack.



## Reconnaissance...VISION...DECISION

When sniper's bullets whip past your head — when you have to send your precious few tanks and men into the teeth of enemy machine guns and artillery fire — that's when good vision counts! When every decision is influenced by what you see — your field glasses become an important instrument of warfare.

Military field glasses need more than the ordinary measure of precision in magnification and field of view. Their value is only as great as their light-gathering power.

YARD is making lenses, prisms and reticles for our Army and Navy. With skill born of tradition in making precision equipment,

YARD technicians work on these optical parts to knowing that only perfection is good enough. Other YARD divisions produce navigation instruments, aircraft hydraulic parts and ranging units, precision testing equipment and precision tools for machined parts. The hope and earnest effort of YARD management and men together is to give our soldiers, sailors, marines and airmen the tools which can win — tools that are the best that can be built — Anywhere.

**YARD INC.**  
PASADENA, CALIFORNIA



The Stinson L-5 "Reliant" has been designed to serve as the eyes of the ground troops and isn't necessary military exhibits, readily as land troops wherever they may go into action. Packed with radio equipment, the pilot and observer can maintain communication and only with all types of ground troops, but with other aircraft as well.



The L-5 150-hp. Lycoming engine lifts the plane almost vertically after a very short run, a vital feature since the pilot must be able to quickly take extremely restricted areas in rough terrain. Built with and design are provided to disassemble and loading gun and its great stability for slow observation flying. Just its low air smoothly high top speed for plane of the type the L-5 can be kept in the air at less than 45 mph for checking troop movements or watching for holes.

## TWO NEW STINSON WARPLANES

DETAILS of two new planes, the L-5 and the AT-19, which have been put in production by the Stinson Division of Vultee Aircraft, Inc., have just been released by the Army Air Force.

The L-5 variant known plane is a two-place high wing monoplane which was 20 percent less steel and 74 percent less aluminum than were called for in original designs. The fuselage is of welded steel tubing. Doors, covers, and the wings and tail surfaces are of wood. Designed to operate wherever ground troops are in action, the L-5 has a very short takeoff run and high rate of climb. Stinson Stinson planes most often look on ordinary roads or rough fields, the spring-loaded shock absorbers have easily twice the length of stroke of conventional types.

Equipped with both slots and landing flaps, the L-5 is said to have an unusually wide range of speed. For ordinary flying, it can be kept in flight at less than 30 mph. Equipment for pilot and observer includes radio units for communication with all types of ground troops as well as other aircraft.

Wing span is 34 ft., length, 26 ft., and weight is 2,100 lb. The L-5 is powered

L-5 Army liaison plane with wide performance range and AT-19, wartime version of "Reliant," for British navigation training.

by a 150-hp. horizontally opposed enclosed Lycoming engine. The AT-19 "Reliant" is being built under AAF direction for assignment to the British as a navigation trainer for British naval fliers. A high, gold shaped strut. The AT-19 is essentially the previous "Reliant" but in what more it has been redesigned, other than the fact that the loadings have been lighter, most, but not have been.







WORK HARDER NOW AND  
**RULE THE SEA IN '43!**

Because of America's output of planes and pilots, the United Nations began to "rule the blue in '42." All-out effort will make good a determination to "rule the sea in '43"—FROM THE AIR. Howard Aircraft personnel will do its utmost to help attain that goal.

**★ Howard Aircraft Corporation ★**  
FOUR THREE SIXTY SEVEN BROADWAY, NEW YORK, N. Y.  
**CONTRACTORS TO THE UNITED STATES NAVY AND ARMY AIR FORCES**



Completely equipped in true multi-engine bomber class is a complete team, the Boeing AT-15. It is really a small bomber. And it is completely equipped even to bomb tanks. Its two Pratt & Whitney engines give the craft a speed in excess of 200 mph.

The AT-15 crew trainer is so arranged that it should be well as group instruction can be given the advanced students who are in the final stages of their training. With its sophisticated layout and power-operated gun turret



## BOEING AT-15 Bomber Crew Trainer

Two engine advanced trainer develops teamwork of pilot, navigators, bombardiers, gunners and cameramen.

THE BOEING AT-15 advanced crew trainer has been designed to train bomber crews as an integral unit, giving the pilot, copilot, bombardier, navigator and gunner the coordination and teamwork which is essential to successful operation of the multi-engine bomber with which the Army Air Forces are piling up their amazing combat record. The craft is so arranged that individual as well as group instruction may be given.

Elimination of the use of strategic

materials such as aluminum castings and alloys was a prime consideration in the design of the plane. The framework is of solid steel tubing construction, wood-plated and fabric covered, while wings and tail surfaces are plywood covered. The AT-15 has a wing span of 50 ft. 9 in. and a length of 43 ft. 2 in. Powered by two Pratt & Whitney engines, opening Hamilton Standard constant speed propellers, it has a

speed that is in excess of 200 mph. Equipment includes radio compass, automatic pilot, full complement of flight and radio equipment, flexible machine gun, flexible camera gun, power turret and bomb bay.

### Troop Officer Revealed

Also in large scale production is the CG-4, 10-mph troop glider designed for service wherever American airborne troops may be called into action. The CG-4 is built almost entirely of wood, using materials and was designed for typical American warm protection methods.

Also coming off the Boeing production lines are large numbers of the CG-4 troop carrying glider, with a capacity of 16 fully equipped soldiers within. The CG-4 is constructed of most entirely of non-metallic materials.

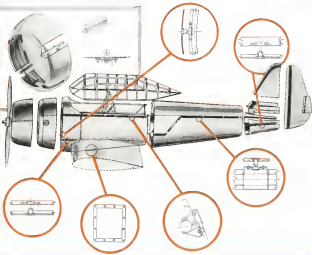
AVIATION, December, 1942



# SPECIFY SHAKEPROOF COWL FASTENERS for Metal and Plywood Applications



Here's how **FLEETWINGS** uses them on its BT-12



## AVIATION ENGINEERS Send for detailed engineering and procurement data book!

Catalog AD 3 is a comprehensive presentation of Shakeproof Cowl Fasteners. It thoroughly explains the advantages of this better fastener and gives complete engineering, procurement and test data. Write for your copy today!

Testing samples are also available to aircraft engineers, buyers and production men.



## SHAKEPROOF inc.

"FASTENING HEADQUARTERS"

2301 North Knicker Avenue, Chicago, Illinois  
Distributors of Shakeproof Products Manufactured by  
KILBOM TOOL WORKS

In Canada: Canada (Montreal) Ltd., Toronto, Ontario

SHAKEFASTENERS • THREAD CUTTING SCREWS • LOCK WASHERS  
COWL FASTENERS • LOCKING AND PLAIN TERMINALS • LOCKING  
SCREWS • BUSH AND INSERTMENT PLUGS SPECIAL STAMPINGS

## Here's Why!

- A standard Shakeproof Cowl Fastener Assembly consists of only three parts—spring nut, nut and cowl plate—is compact in size and light in weight.
- Shop assembly operators are reduced to its least complexity, requiring only standard drilling and tapping procedures, and insertion of the cowl pin in the nut and lock special plate.
- Ground crew replacement is correspondingly simplified and special adapters are available to permit installation where parts have been coated for greatest type fastener.
- Shakeproof Cowl Fasteners also have the advantage of actually reinforcing rather than weakening the adjacent structural area—thus insuring any possibility of distortion in stress area sheets.
- The reinforced base also eliminates load concentration and thus removes the danger of stress fractures, particularly those at the aluminum attaching rivets.
- Through equalized springing the deflection of the spring nut is definitely limited. The base is formed to provide continuous positive support when the upper locking bridge reaches the pre-determined limiting point.
- When the Shakeproof Cowl Fastener is moved to the locked position, a pair of aluminum or scope grooves further raising of the nut. The assembler thus has assurance that the fastener is locked tight.
- Cover plate, cowling, or other curved or shaped items attached with Shakeproof Cowl Fasteners may be readily removed without bending on the part of the individual studs—a definite advantage over prominent type nuts.
- The design of the fastener permits quick alignment of the sheets to be fastened, can penetrate for rivets on sheet thicknesses and provides for addition of accessories such as stud guide springs and right angle mounting brackets.

BE SURE TO SEND FOR SHAKEPROOF COWL

FASTENER CATALOG!

# BE READY FOR WINTER'S ATTACK

## INSPECT AND EQUIP YOUR FWD's NOW... FOR FAST LOW-COST AIRPORT SNOW CLEARING



Handicaps of FWD's, similar to this model, will soon be put to rest as the winter's work-filled with snow-clearing equipment and snowplows ready to get into action tonight snow after a heavy snow and summer on regular airport maintenance work.



## KEEPING 'EM IN THE BLUE . . . Calls For Good Clear Runways Below . . .

Keep 'em flying by giving 'em runways clear and clean of snow. At airports in every state in the snow belt and many Canadian provinces (where heavy snowfalls are a constant menace) FWD trucks are being made ready for snow clearing duty—a service in which they have earned and kept first place.

In cooperation with the aims of the U. S. Truck Conservation Program, FWD lists here a few practical suggestions to enable airport operators to get the most in performance with maximum maintenance out of their FWD snow removal trucks:

**Conserve tires**—snow removal truck operators are universally agreed that single tires are best in snow removal service. The use of single tires of the same size on all four wheels not only conserves rubber but also reduces excessive differential action, thus prolonging the life of the truck. Closely spaced tire chains—not emergency chains—should be used on all four wheels for maximum traction and least slippage and damage to tires.

**Care of engine**—change engine oil frequently enough based on total hours of operation. Keep cooling system clean and free of rust. Control engine temperature with a radiator hood or automatic shutter.

**Sharpen the track**—sub-zero temperatures make lubricants too stiff and solid, cause steels to become brittle. Haul all your trucks when not in use—avoid outdoor storage for longer truck life.

**Inspect your trucks**—periodically and check for needed replacements—take advantage of FWD's principle of progressive interchangeability of improvements and vital parts.

### See Your FWD Branch or Dealer

The entire FWD organization of factory branches, FWD dealers, and district engineers are all pledged to help you get the most out of your trucks by aiding your program of preventive maintenance. Call on them frequently for sound maintenance advice and skilled service.

### THE FOUR WHEEL DRIVE AUTO COMPANY

CLINTONTVILLE, WISCONSIN • Canadian Factory: Kitchener, Ont.

WINTER MAINTENANCE



**FWD**  
TRUCKS

—THE PREPARATION TRUCK  
FOR FAST, LOW-COST  
AIRPORT SNOW CLEARING



ONLY THE FWD FOUR-WHEEL-DRIVE TRUCK PROVIDES SO MANY OUTSTANDING SNOW REMOVAL ADVANTAGES





## 111

## CALLING NAMES

## Reclassification Opens Aircraft Jobs

Harry Winkfield, president of Winkfield, was elected president of Valley Aircraft, a Los Angeles aircraft repair shop, in 1943. He is also president of Valley Aircraft.

George Borge has been selected as the 1943 president of the American Society for Aeronautical Engineers in the field of aircraft design and development. He is also president of the American Society for Aeronautical Engineers in the field of aircraft design and development.

Thomas P. Kibbel, Jr., president of Kibbel, Jr., is also president of Kibbel, Jr. He is also president of Kibbel, Jr.

Herbert O. Nelson, president of Nelson, is also president of Nelson. He is also president of Nelson.

E. B. Borge, formerly with General Motors, has been selected as president of the American Society for Aeronautical Engineers in the field of aircraft design and development.

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TEAMWORK DOES IT

Mounted only by small rivets, Mrs. Elizabeth Loughlin has been tested often as a test harness for the Aero Tool Company, Inc. Her work with a rivet is a 4 in. square Tension Rivet.

There are 100 different kinds of rivets in production for the aircraft industry. The Aero Tool Company, Inc. has developed a new method of riveting which is called the Aero Tool Rivet.

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# ERCO

## Automatic Riveters

## Now Represented by

# AERO TOOL CO.

## On the Pacific Coast



**ENGINEERING RESEARCH CORPORATION**  
manufacturers of Erco Automatic Riveting Equipment, is now represented in the West by the Aero Tool Company.  
Erco Riveters are the only single unit machines

that punch, dimple and rivet, saving many hours and reducing multiple operations in aircraft construction. The trained Erco service staff of the Aero Tool Company is now at the disposal of Pacific Coast manufacturers.

**AERO TOOL COMPANY • 231 WEST OLIVE AVE., BURBANK**

# INDUSTRY IS ON AN EIGHT-DAY WEEK



Seven days a week America is doing one of the greatest jobs of production the world has ever known. We are living with one part of that job here at Alcoa, where over seventy thousand men and women are producing aluminum in quantities that were once fantasy yesterday.

But there's an eighth day tucked in among the five open spaces in the seven-day week. Engineers are able to squeeze in some important engineering ideas, portable products—planning that will help convert new jobs into price jobs.

For instance:

Imagine what 1,000 pounds less weight in the automobile of the future would mean in performance, gas economy and tire life. Then engineer it down

to the realization that 1,000 pounds can be taken off by using, say, 500 pounds of aluminum per car.

New technical possibilities such as these join your own brains.

Aluminum costs less today. New methods, techniques, processes, and new forms of metal coming out of the new effort will all be available for the next-to-eighth possibilities in tomorrow's portable products and portable services.

Our eighth day is devoted to helping designers throughout industry use the possibilities of Alcoa Aluminum in bettering the new ideas they are designing. For ALUMINUM COMPANY OF AMERICA, 2102 Golf Building, Pittsburgh, Pennsylvania.



## ALCOA ALUMINUM



## Plane Production Levels Off; Higher Output of Bombers Raises Value

Washington (Associated Press)—Alcoa's production of aluminum for the aircraft industry has leveled off at 30 percent of peak output. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.

The New Production Board and the Production Administration are now taking the steps to cut back the production of aluminum for the aircraft industry. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.

Since the entire weight of aircraft is accounted for aluminum, the company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.

### New Interstate Plant

Construction of the Alcoa's new plant in the Washington area is well advanced. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.

Substitution for the new plant will be the Alcoa's Washington plant. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.

Production changes prompted by establishment of the National Production Administration by President Roosevelt have caused the company's output of aluminum for the aircraft industry to level off at 30 percent of peak output.

### GM Steps Up Production

Over half the new aircraft production at General Motors is now being produced at the company's new plant in the Washington area. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.

Two other divisions—Alcoa and Alcoa's new plant in the Washington area—are also producing aluminum for the aircraft industry. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.

A new type variable pitch propeller is in production at the Alcoa's new plant in the Washington area. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.



FINAL CHECK UP

Workers check over a new variable pitch propeller. It will be used on the new plant in the Washington area. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.

production machine from 100 to 150 horsepower. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.

### Special WPP Group

Washington (Associated Press)—The new group of aircraft production companies, known as the Special WPP Group, is now producing aluminum for the aircraft industry. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.

Members of the board that is now taking the steps to cut back the production of aluminum for the aircraft industry. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.

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A new type variable pitch propeller is in production at the Alcoa's new plant in the Washington area. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.



FINAL CHECK UP

Workers check over a new variable pitch propeller. It will be used on the new plant in the Washington area. The company's output of aluminum for the aircraft industry has leveled off at 30 percent of peak output.



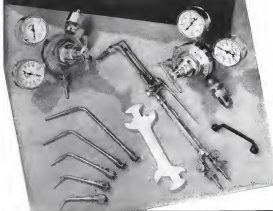


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Over 15,000 Combination Welding and Cutting Units like the one here distributed now under the services of our armed forces.

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dependable  
**Alloy Steels**

If we can help you in selecting and applying these steels to your requirements, don't hesitate to call on us. The services of our metallurgists are freely at your disposal. This offer is open to every user of Carnegie-Illinois Steels and to every manufacturer of war equipment.

\*As published September, 1941 by the American Iron and Steel Institute, at "Dispositions in the Metallurgy of Steels," Pamphlet No. 8—Supplementary National Emergency Steels.

**CARNEGIE-ILLINOIS STEEL CORPORATION**

*Pittsburgh and Chicago*

Columbia Steel Company, Inc. (Pittsburgh) Pacific Coast Division

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# UNITED STATES STEEL

CARBON-MANGANESE STEELS			
Grade	Yield Point (lb./sq. in.)	Tensile (lb./sq. in.)	Elongation (in. per ft.)
A572-50	50,000	60,000	21
A572-60	60,000	70,000	18
A572-70	70,000	80,000	15
A572-80	80,000	90,000	12
A572-90	90,000	100,000	10
MANGANESE-NICKEL-STEELS			
Grade	Yield Point (lb./sq. in.)	Tensile (lb./sq. in.)	Elongation (in. per ft.)
A514	51,000	61,000	21
A516	51,000	61,000	21
A517	51,000	61,000	21
CARBON-NICKEL-STEELS			
Grade	Yield Point (lb./sq. in.)	Tensile (lb./sq. in.)	Elongation (in. per ft.)
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A509	50,000	60,000	21
A510	50,000	60,000	21
SILICO-MANGANESE AND SILICO-MANGANESE-CHROME STEELS			
Grade	Yield Point (lb./sq. in.)	Tensile (lb./sq. in.)	Elongation (in. per ft.)
A521	52,000	62,000	21
A522	52,000	62,000	21
A523	52,000	62,000	21
MANGANESE-SILICO-CHROME STEELS			
Grade	Yield Point (lb./sq. in.)	Tensile (lb./sq. in.)	Elongation (in. per ft.)
A524	52,000	62,000	21
A525	52,000	62,000	21
A526	52,000	62,000	21
MANGANESE-SILICO-CHROME-NICKEL-MOLYBDENUM STEELS			
Grade	Yield Point (lb./sq. in.)	Tensile (lb./sq. in.)	Elongation (in. per ft.)
A527	52,000	62,000	21
A528	52,000	62,000	21
A529	52,000	62,000	21
CARBON-CHROME STEELS			
Grade	Yield Point (lb./sq. in.)	Tensile (lb./sq. in.)	Elongation (in. per ft.)
A530	53,000	63,000	21
A531	53,000	63,000	21
A532	53,000	63,000	21

### Panagra Wants Terminal Stations in U. S.

Washington (Antennas Etc.)—A serious air transport bottleneck has developed between this country and the Caribbean region. The obvious reason is lack of sufficient equipment to serve bulging air traffic.

The Civil Aeronautics Board recently issued an invitation to any qualified companies to apply for route certifications. Evidently the board believes there might be operators suitably situated who could take equipment from other services for new routes which it might authorize. CAB invited foreign applicants as well as domestic.

Twenty or fourteen applications already had been received at this writing. Among them were Eastern Air Transport, KLM (Royal Dutch), Air Canada, British West Indies, TACA Intercontinental with DWT, Macdonald Airline of Florida and the OAG and SAS.

The committee is making age brackets for Charleston residents to make a more accurate survey of the work force and to determine to what extent equipment on existing services could be moved to new services with advantage. In the War Office, he heard fully realize that all equipment and personnel are already employed. No specific studies were set up in the War Office. Hearings will begin and turn to the need for additional services and those which affect the War President. Second and the Army to allocate more men to units to do the services that can be established.

Another factor in the Latin-American air battleship is an action mandated by OAS to determine whether the doctrine of Pan American-Grace should be amended to include also or even limited by the United States with direct interest: Miami, Tampa, New Orleans, Brownsville, El Paso, or Los Angeles.

Paragait's operation between Dallas, O. 2, and Buenos Aires via the West Coast of South America. Paragait is owned 50 percent by W. B. Grant Company and 50 percent by Pan American Airways. Paragait's natural desire for a terminal in the United States proper is also

mented by the fact that much of its traffic must come to it over PAA American's routes southward out of the U. S. The two associated companies are said to have had disagreements over this question, and over the division of traffic between the West Coast and the East Coast, which is flown by PAA. They will appear each other in the near future.

According to the board's



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Flourishing today will grow by leaps on the air, land, and water, as it does by the power of students at United War Labor College School of Administration where the young women are training to become shipgirls and radio operators to work alongside men in the country's commercial vessels.

order, the Qmex ownership stated that Phosag, because of the opposition of its 96 percent Pan American stockholders is not authorized by its directors to make application for an amendment providing for a Phosag's transfer in the U.S. Thus the action was initiated by the government.

### Military Return Flights Cover U. S. Vital Goods

Now it can be said that the Army Air Transport Command is flying strategic goods on airmail trips to the United States. The announcement was withdrawn by the Army's press unit, however.

The internationalization worked out by the Bureau at Economic Warfare with its branches all over the world made this service possible. For example, PCWW set up stations in the Far East, where courts swayed

are assembled from scattered points in China for air transport to the United States.

**China. No Line: Aviation.** (Pan American Airways) carries mail, passengers, and mail to airports in China, from where they are taken to their country by Army or Navy. In eight weeks 150 tons of these items plus 20 tons of supplies were moved from China to India. Later, in time of emergency, while flows out in less than

The Army Transport system, includes overseas operations by

### McLennan Radio School

At Wesleyan College, Iowa,  
A. Fiedler addresses students in  
his lecture.

air transportation to prepare students for job opportunities in that sector. The program

## All-Game Flight: None

United Air Lines Flight 18 is operating as an all-weather trip between New York and Salt City as a means of expediting critically needed war materials. United had experimented with all-weather flights in the past with the intention of gaining experience for future use. Eastern Air Lines also is making a daily cargo trip between New York and Miami.

Journal of Management Inquiry 20(4) 409-424

ALL CARS RULTE TO SOUTH AFRICAN

Unloading at Lima, Peru, is a Panagra plane standing on the first inter-national air ramp service to be provided by the C&D. Regularly scheduled only twice a week, the plane maintains schedules between Barbo (C) & Lima and intermediate points. Up to 20 tons of merchandise have been moved in a week, and the service was inaugurated.

AVIATION December 1942

But there is one vital part which maintenance men seldom have to touch, although they notice it often enough: The Torrington Needle Bearing, "changed over" to production-of-the-war, is again demonstrating its efficiency—and adaptability—in applications where its unique advantages mean more today than ever.

Lightweight, compact, and rugged, the 1000 is filling some important waterjet needs. Its small size is saving weight and critical materials, its remarkable ease of installation is cutting assembly time, its simplified design is eliminating extra parts and assembly steps, with less coefficient of friction and more smoothly performance.

## TORRINGTON NEEDLE BEARING

Every feature fills a wartime need.

IF YOU HAVE A PROBLEM with the Needle Bearing unit, please contact the nearest representative of the manufacturer. The manufacturer can be of valuable assistance in adapting an alternative to your needs. You can also come to their experts, as well as the information on Needle Bearing separation and more in Catalog No. 114.

State/Province	Region	State/Province	Region
Alabama	Mobile	Alabama	Mobile
Alaska	Juneau	Alaska	Juneau
Arizona	Phoenix	Arizona	Phoenix
Arkansas	Fayetteville	Arkansas	Fayetteville
California	San Francisco	California	San Francisco
Colorado	Denver	Colorado	Denver
Connecticut	Hartford	Connecticut	Hartford
Delaware	Dover	Delaware	Dover
Florida	Tallahassee	Florida	Tallahassee
Georgia	Atlanta	Georgia	Atlanta
Hawaii	Honolulu	Hawaii	Honolulu
Idaho	Boise	Idaho	Boise
Illinois	Chicago	Illinois	Chicago
Indiana	Indianapolis	Indiana	Indianapolis
Iowa	Des Moines	Iowa	Des Moines
Kansas	Topeka	Kansas	Topeka
Kentucky	Louisville	Kentucky	Louisville
Louisiana	Baton Rouge	Louisiana	Baton Rouge
Maine	Portland	Maine	Portland
Maryland	Baltimore	Maryland	Baltimore
Massachusetts	Boston	Massachusetts	Boston
Michigan	Lansing	Michigan	Lansing
Minnesota	Minneapolis	Minnesota	Minneapolis
Mississippi	Jackson	Mississippi	Jackson
Missouri	St. Louis	Missouri	St. Louis
Montana	Billings	Montana	Billings
Nebraska	Omaha	Nebraska	Omaha
Nevada	Reno	Nevada	Reno
New Hampshire	Manchester	New Hampshire	Manchester
New Jersey	Newark	New Jersey	Newark
New Mexico	Albuquerque	New Mexico	Albuquerque
New York	New York City	New York	New York City
North Carolina	Raleigh	North Carolina	Raleigh
North Dakota	Bismarck	North Dakota	Bismarck
Ohio	Columbus	Ohio	Columbus
Oklahoma	Oklahoma City	Oklahoma	Oklahoma City
Oregon	Portland	Oregon	Portland
Pennsylvania	Philadelphia	Pennsylvania	Philadelphia
Rhode Island	Providence	Rhode Island	Providence
South Carolina	Columbia	South Carolina	Columbia
South Dakota	Spearhead	South Dakota	Spearhead
Tennessee	Nashville	Tennessee	Nashville
Texas	Austin	Texas	Austin
Utah	Salt Lake City	Utah	Salt Lake City
Vermont	Montpelier	Vermont	Montpelier
Virginia	Richmond	Virginia	Richmond
Washington	Seattle	Washington	Seattle
West Virginia	Charleston	West Virginia	Charleston
Wisconsin	Madison	Wisconsin	Madison
Wyoming	Cheyenne	Wyoming	Cheyenne

1. Uniform Diameter
2. Uniform Wall Thickness
3. Uniform Concentricity
4. Uniform Strength (with a wall as strong as the wall)
5. Uniform Weight
6. Uniform Quantity
7. Uniform Hardness
8. Uniform Weldability
9. Uniform Scale-Free Surface

Address: 800 N. Hwy. 96E

It is made of S.A.E. X-4130 steel in sizes from N° O.D. to 1N° O.D.—.028" to .065" wall; of S.A.E. 1025 steel in sizes from N° O.D. to 4" O.D.—.028" to .148" wall; and of ENDURO® Stainless Steel in standard analyses in sizes from N° O.D. to 3" O.D.—.028" to .130" wall.

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REPUBLIC STEEL CORPORATION  
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Human Resources Development Division : Culture Division : Human Resources Development  
Human Resources Development Division : Culture Division : Human Resources Development

*Republic* \_\_\_\_\_  
ELECTRUNITE

ELECTRIC RESISTANCE WELDED TUBING

Also Baller Tubes : : Condenser and Heat Exchanger Tube



potent member of the crew of a modern heavy bomber.

### Benefits to the Late Action

While it has been known for some time that American surprise planes were in operation in the waters off the coast, frequent legends have been told that had been on balloons and very recently that these planes had been used in actual attacks upon the enemy. According to the Australian War Minister, Arthur Gahan, the planes had been used for some time in observation and reconnaissance flights along the Australian coast and had operated with marked success against submarines. However, a full-scale torpedo attack was not expected to occur during September with exact details as to what further force of this type can be expected in the future.

### New Type Concrete Shell

Reports from Moscow indicate that the Gorgona may be using a new type of casing drill in their MR-100's which enables them to open holes at 100, 200, 300, 400, 500, 600, 700, 800, 900, 1,000, 1,200, 1,400, 1,600, 1,800, 2,000, 2,200, 2,400, 2,600, 2,800, 3,000, 3,200, 3,400, 3,600, 3,800, 4,000, 4,200, 4,400, 4,600, 4,800, 5,000, 5,200, 5,400, 5,600, 5,800, 6,000, 6,200, 6,400, 6,600, 6,800, 7,000, 7,200, 7,400, 7,600, 7,800, 8,000, 8,200, 8,400, 8,600, 8,800, 9,000, 9,200, 9,400, 9,600, 9,800, 10,000, 10,200, 10,400, 10,600, 10,800, 11,000, 11,200, 11,400, 11,600, 11,800, 12,000, 12,200, 12,400, 12,600, 12,800, 13,000, 13,200, 13,400, 13,600, 13,800, 14,000, 14,200, 14,400, 14,600, 14,800, 15,000, 15,200, 15,400, 15,600, 15,800, 16,000, 16,200, 16,400, 16,600, 16,800, 17,000, 17,200, 17,400, 17,600, 17,800, 18,000, 18,200, 18,400, 18,600, 18,800, 19,000, 19,200, 19,400, 19,600, 19,800, 20,000, 20,200, 20,400, 20,600, 20,800, 21,000, 21,200, 21,400, 21,600, 21,800, 22,000, 22,200, 22,400, 22,600, 22,800, 23,000, 23,200, 23,400, 23,600, 23,800, 24,000, 24,200, 24,400, 24,600, 24,800, 25,000, 25,200, 25,400, 25,600, 25,800, 26,000, 26,200, 26,400, 26,600, 26,800, 27,000, 27,200, 27,400, 27,600, 27,800, 28,000, 28,200, 28,400, 28,600, 28,800, 29,000, 29,200, 29,400, 29,600, 29,800, 30,000, 30,200, 30,400, 30,600, 30,800, 31,000, 31,200, 31,400, 31,600, 31,800, 32,000, 32,200, 32,400, 32,600, 32,800, 33,000, 33,200, 33,400, 33,600, 33,800, 34,000, 34,200, 34,400, 34,600, 34,800, 35,000, 35,200, 35,400, 35,600, 35,800, 36,000, 36,200, 36,400, 36,600, 36,800, 37,000, 37,200, 37,400, 37,600, 37,800, 38,000, 38,200, 38,400, 38,600, 38,800, 39,000, 39,200, 39,400, 39,600, 39,800, 40,000, 40,200, 40,400, 40,600, 40,800, 41,000, 41,200, 41,400, 41,600, 41,800, 42,000, 42,200, 42,400, 42,600, 42,800, 43,000, 43,200, 43,400, 43,600, 43,800, 44,000, 44,200, 44,400, 44,600, 44,800, 45,000, 45,200, 45,400, 45,600, 45,800, 46,000, 46,200, 46,400, 46,600, 46,800, 47,000, 47,200, 47,400, 47,600, 47,800, 48,000, 48,200, 48,400, 48,600, 48,800, 49,000, 49,200, 49,400, 49,600, 49,800, 50,000, 50,200, 50,400, 50,600, 50,800, 51,000, 51,200, 51,400, 51,600, 51,800, 52,000, 52,200, 52,400, 52,600, 52,800, 53,000, 53,200, 53,400, 53,600, 53,800, 54,000, 54,200, 54,400, 54,600, 54,800, 55,000, 55,200, 55,400, 55,600, 55,800, 56,000, 56,200, 56,400, 56,600, 56,800, 57,000, 57,200, 57,400, 57,600, 57,800, 58,000, 58,200, 58,400, 58,600, 58,800, 59,000, 59,200, 59,400, 59,600, 59,800, 60,000, 60,200, 60,400, 60,600, 60,800, 61,000, 61,200, 61,400, 61,600, 61,800, 62,000, 62,200, 62,400, 62,600, 62,800, 63,000, 63,200, 63,400, 63,600, 63,800, 64,000, 64,200, 64,400, 64,600, 64,800, 65,000, 65,200, 65,400, 65,600, 65,800, 66,000, 66,200, 66,400, 66,600, 66,800, 67,000, 67,200, 67,400, 67,600, 67,800, 68,000, 68,200, 68,400, 68,600, 68,800, 69,000, 69,200, 69,400, 69,600, 69,800, 70,000, 70,200, 70,400, 70,600, 70,800, 71,000, 71,200, 71,400, 71,600, 71,800, 72,000, 72,200, 72,400, 72,600, 72,800, 73,000, 73,200, 73,400, 73,600, 73,800, 74,000, 74,200, 74,400, 74,600, 74,800, 75,000, 75,200, 75,400, 75,600, 75,800, 76,000, 76,200, 76,400, 76,600, 76,800, 77,000, 77,200, 77,400, 77,600, 77,800, 78,000, 78,200, 78,400, 78,600, 78,800, 79,000, 79,200, 79,400, 79,600, 79,800, 80,000, 80,200, 80,400, 80,600, 80,800, 81,000, 81,200, 81,400, 81,600, 81,800, 82,000, 82,200, 82,400, 82,600, 82,800, 83,000, 83,200, 83,400, 83,600, 83,800, 84,000, 84,200, 84,400, 84,600, 84,800, 85,000, 85,200, 85,400, 85,600, 85,800, 86,000, 86,200, 86,400, 86,600, 86,800, 87,000, 87,200, 87,400, 87,600, 87,800, 88,000, 88,200, 88,400, 88,600, 88,800, 89,000, 89,200, 89,400, 89,600, 89,800, 90,000, 90,200, 90,400, 90,600, 90,800, 91,000, 91,200, 91,400, 91,600, 91,800, 92,000, 92,200, 92,400, 92,600, 92,800, 93,000, 93,200, 93,400, 93,600, 93,800, 94,000, 94,200, 94,400, 94,600, 94,800, 95,000, 95,200, 95,400, 95,600, 95,800, 96,000, 96,200, 96,400, 96,600, 96,800, 97,000, 97,200, 97,400, 97,600, 97,800, 98,000, 98,200, 98,400, 98,600, 98,800, 99,000, 99,200, 99,400, 99,600, 99,800, 100,000, 100,200, 100,400, 100,600, 100,800, 101,000, 101,200, 101,400, 101,600, 101,800, 102,000, 1

Further British Coverage:

—Can we please get the program on the air?

These channels were then converted to synoptic planes for the Coastal Commission where their 370-mi length and 1,000-mi range prove extremely useful for the extended patrolling which is now underway.

### Eine Kiffing Expedition

The Aer Lingus Tourists, the Irish Aviation company, has opened its first intercontinental service between Dublin and London. The line may be extended to Gough later on.

Time of 12 patients is to provide a more efficient look with the outstanding service of Fox America and American Express.

## ON SCHEDULE by "Mista"

**For about seven months** the Swedish AMS airline, operating in the face of emergency difficulties, has maintained a night mail service non-stop from Stockholm to Great Britain. At present this line is being operated on a weekly schedule with Junkers 52s, of which the AMS has quite a few, and it is quite remarkable that this service can be maintained over this notoriously bad stretch of territory. It is hoped that eventually the line will be developed into a major passenger route, enabling the best before the Holland and Germany which was suspended before that.

The word "bath" has been written up officially across the record of the Santa LITA corporation, and which means New Dawn Brazil is likely to Foreign Minister Antonio de Azevedo. The State officials look over the large flying boats which LAFT had laid up in the Amazon, and started operations on a new line by the Amazon to rubber plantations which are now being developed. It is rather strange and also pleasing that these planes which were assigned to carry Indians and rubber tappers were now being used to carry rubber tappers. It was said that the Atlantic was not a safe place to be in, and to say, we should not.

**Proposals for British Overseas Airways**, now circulating to

He also passed on an old Westport production that featured three clowns, with a little brother last month. During a discussion in the House of Commons the Secretary of State for Wales said whether such action was justified was for the courts to decide, not members of another branch, now known as the Welsh Government's senior spokesman. Sir Archibald Clark, now a consultant for England's courts, informed the House in protest that such action had already been taken. From all appearances therefore, BOND will soon be able to replace the arrested and aged parent with something a little faster and safer, which is sure should be the surfing operators a lot of good.

Jonathan Cordes Flying  
Schools

The No. 5 Air Observer School at St. Johns F. G. is typical college of the air where students undergo intensive and highly technical instruction in a compressed cycle of time. Operated by American Airways Observer Ltd., under the operation of Canadian Pacific Air Lines Ltd., this school forms part of the Empire Air Training Program which must equip the manpower for the coming offensive.

The BIAF part of the show is directed by a ranking Air Force major, as the chief supervisory officer. The BIAF applies all the ground instruction and firm the readiness of their theoretical

- 1 Supply all the clothing and shoes for flying the air operations in all theatres. Must also come from Canada and the U.S. or not necessary.
- 2 Be responsible for the maintenance of all aircraft, supply all radio instruments and communications with their operators and speech.
- 3 Supply all catering of the crew.
- 4 Be responsible for operation and maintenance of a

- Provide all equipment to keep the school going during and after
- Maintain all necessary records such as fire-drill, evacuation etc

I be responsible for all heating fuel, baggage storage, and whatever else is needed for the operation of the school. The project camp has about 200 civilian employees and its size is being doubled.

that, when expanded, it tripled the number of place instructors and output of infrared simulators will be tripled in Canada continues to supply, make and more skilled workers to the United Nations.

*First enemy met on icy mornings...*

## SURGE PRESSURE

CAUSE:

*Oil thickened by freezing temperatures creates excessive pressure on congealed oil cooler when engine starts.*

RELIEF

Standard - type pressure relief valve by-passes oil cooler core - but does not protect cooler against possible back-pressure from congested oil lines!

CURE:

**A NEW-AND PROVEN-DESIGN FOR  
"SURGE PROTECTION"**



AiResearch Oil Cooling Systems now provide *full, automatic* "Surge-Protection"

**U**P TO NOW, the surge of cold, thick oil has constantly threatened the oil system during engine starting in sub-zero weather. By passing his heated waste heat to the oil, the pump pressure is directed around the oil cooler, waste pressure will back into the oil cooler and dilute the cold oil.

complex by-pass through cooling the exhaust to the oil cooler—preventing it against excessive back pressure. It maintains safe pressure in the cooler itself to insure fast flow out, ... helps build and maintain full pressure necessary to clear oil lines. And it increases engine safety by assuring

proper oil "conditioning" is a minimum amount of time.

Fully automatic, this new "large-protection" for Allisonair Oil Coolers is now in volume production. Manufacturers, interested in the safety advantages it offers their aircraft, may write or wire for full details.

AdResearch mastered its specialized "know-how" to help this problem. The answer developed by our engineers has recently been field-tested. Complete, automatic "captive-proofing" is now an accomplished fact!



Affleworth's "safety-protection" is insured by a pressure sensitive element that monitors the oil pressure and then directs the flow of oil accordingly to safety requirements.

**"Where Controlled Air Does The Job" • Engine  
Systems • Components • Accessories**

If private is extensive, it proceeds

AVIATION December 1967

AVIATION December 1961



There is new pride in the flight of our symbolic Thunderbolt—a pride born with our exclusive appointment to give Chinese Air Force cadets their all-American primary training—a pride shared by every Southwest Airways employee.

It is a responsibility, too—one that we have not, and shall not, bear lightly. Throughout our growth in Arizona's Valley of the Sun to one of the Nation's largest primary schools, we have worked consistently with the Army Air Force to develop safer, more efficient training. When Victory is won, these skills will be turned again to peacetime tasks.

But today, our job is clear. We are giving wings to the American Eagle—and now the dragon shall fly!

## SOUTHWEST AIRWAYS

IMMERSION IN FLIGHT • PAPER IN FLIGHT • DAY HARBOR • THUNDERBOLT IN TRAINING THE FIRST FIGHTERS TODAY, THE FIRST FLIGHTS TOMORROW  
CONTRIBUTION TO THE UNITED STATES GOVERNMENT • UNITED STATES AIR FORCE • UNITED STATES GOVERNMENT

THUNDERBOLT



**DENNIS DEAN JACKSON** has been appointed director of labor relations for SWA's newly created office. Mr. Jackson has been assistant state labor controller at Minnesota since 1959. Before that, was a general consultant and member of Minnesota's last labor commission. ERNEST W. YOUNG, former Seattle police official, was appointed director of general security. He will have complete charge of all guard and patrol activities in the system. He will make sure all other law officers in power will have adequate the question of security and street jobs.



**EDWIN ALTSHULER**, former chief editor of Aviation, and current chief executive officer of TWA's western division, was appointed to the Southwest and Northwest divisions. He will be in charge of all operations in the western division. He will be in charge of all operations in the western division. He will be in charge of all operations in the western division.



**A. C. SMILEY**, formerly executive manager of the Division of Finance of the United States Department of the Interior, was appointed to the position of executive manager of the Division of Finance of the United States Department of the Interior.



**EDWARD G. BITER**, has been appointed chief of the Division of Finance of the United States Department of the Interior. He is a member of the United States Department of the Interior.



**WILLIAM F. MCGRATH**, former transportation and then general manager of TWA, was appointed general manager of TWA. He is a member of the United States Department of the Interior.



**CAPT. E. V. RICKENBACKER**, chief of the United States Department of the Interior, was appointed to the position of chief of the United States Department of the Interior.



**J. M. HEFNER**, former chief of the United States Department of the Interior, was appointed to the position of chief of the United States Department of the Interior.



**OSCAR MURPHY**, former chief of the United States Department of the Interior, was appointed to the position of chief of the United States Department of the Interior.



**ROBERT B. SPENCER**, former chief of the United States Department of the Interior, was appointed to the position of chief of the United States Department of the Interior.



**I. S. CHARNOFF**, former chief of the United States Department of the Interior, was appointed to the position of chief of the United States Department of the Interior.



**C. F. SHINDLER**, former chief of the United States Department of the Interior, was appointed to the position of chief of the United States Department of the Interior.



**LESTER GEORGE C. KERNEN**, former chief of the United States Department of the Interior, was appointed to the position of chief of the United States Department of the Interior.



**ARTHUR JOHNSON**, former chief of the United States Department of the Interior, was appointed to the position of chief of the United States Department of the Interior.



**JAMES H. MCLAUGHLIN**, former chief of the United States Department of the Interior, was appointed to the position of chief of the United States Department of the Interior.

**QUALITY**  
LIKE GOOD BREEDING  
*is the Hall-mark*  
OF  
**THOROUGHBREDS**



## Hansen

INDUSTRIAL AIR LINE  
EQUIPMENT

For the past quarter of a century, Hansam air line equipment has been the outstanding quality line, never built down to meet a price but always maintained at a high quality level.

Hansen quality means more than just a talking point. It means advanced engineering, full line accuracy, skilled craftsmanship and the finest materials obtainable. Hansen's reputation is

Thousands of large and small industrial plants throughout the world are complete.

Hansen—a name which means the finest in modern air line equipment that more than meets the demands of today's production and tomorrow's competition. Read for free details.

WIDE CLAMPS • JIB BOOM COMPRESSOR  
WIDE CLAMP JACKETS • WIDE CLAMP PULPS  
AIR DRUM SPRAY GUNS • JIBBOE CLEANERS  
AIR FLOW METER • JAWBOLT CLEANING



**Hansen** MFG. CO.  
INDUSTRIAL *Air Line* EQUIPMENT  
1766 EAST 37TH STREET . . . CLEVELAND, OHIO

**The first large Regulation Y** loans for the aircraft industry to reach the New York capital market have been awarded by Lockheed Aircraft Corp. and its subsidiary Vega Aircraft Co. The Lockheed loan of \$100,000,000 will be managed by Eastern Trust Co. while the \$100,000,000 Vega loan will be handled by the Central Business Bank & Trust Co.

**Preparations** for a \$100,000,000 loan of the same type for Berlin Aerial Corp. are being completed and the loan will be managed by a Midwestern bank. Briefly the V-type loan provides for a commitment guarantee up to 80 percent of the amount borrowed and they are all negotiating upon completion of deliveries under war contracts.

Large banking groups, ranging from a dozen to several hundred institutions join together to make the funds available as the amounts rise or lower. One would be, would be.

be used then indirectly under the banking law. Amounts that can be loaned in any one situation are strictly limited under the law. In some cases the strictness may be lessened by contracts directly through the government, without participation by the banks. The Federal Reserve permits private banks to make arrangements with the government for example, used not to be approved as these are loans apply to a commercial bank's contracts.

United Aircraft's third quarter report provides one of the few views on the subject of 1942 earnings of aircraft companies as nearly all other concerns came under the Army's technical report ban. United earned \$28,415,000 or \$134 a share for the first nine months, compared with \$16,775,000 or \$44.6 a share in the 1941 period.

valued in the 1942 period. United set aside a special \$400,000 war-time reserve. The dollar volume of shipments for the time war was about 80 percent larger than a year ago, but earnings showed a moderate decline due to the lower prices now obtaining on war products delivered to the United States government. Total net reserves were slightly lower than last year.

United Aircraft has moved into the million-dollar class, a distinction that was held by

\* \* \* By RAYMOND HOADLEY \* \* \*

[illegible]

**October payments.** It should also be noted that the second round of top pay raises will come in November, according to the *Washington Post*. The *Post* reports that the House of Representatives may not pay out any raises until just past year-end, on the other hand a number of private companies, such as IBM, have already announced that they will begin paying raises after a three-day lapse.

The IRS will also continue to make push to get around the provisions that have been requested. Since the improved provisions would allow a company to deduct the cost of the new plan, it would also allow a corporate tax rate of 35 percent, as opposed to the 46 percent rate that would be applied to the new plan. The IRS has also asked a corporate tax rate of 35 percent, as opposed to the 46 percent rate that would be applied to the new plan. The IRS has also asked a corporate tax rate of 35 percent, as opposed to the 46 percent rate that would be applied to the new plan.

From the thousands of aircraft companies the best rated about the past few years is the 10 percent tax offset. About 100 companies are expected to receive the new law's benefits. The largest of these are the aircraft manufacturers. They are expected to receive the most benefits. The largest of these are the aircraft manufacturers. They are expected to receive the most benefits. The largest of these are the aircraft manufacturers. They are expected to receive the most benefits.

\*\*\*\*\*

**Shareholders of alcohol companies are getting their year's dividend payments in one sweep. Among the recent declarations are Double Harvest, a Wisconsin distiller of alcohol, 80¢ a share.**

[illegible]

The point deposit in the First State account was \$61,732,000, of which the aircraft subsidiary accounted for \$11,500,000. EARNINGS for the same period were \$1,975,000 as \$437.5 a share yielded \$1,054,380 or \$120.7 a share in the last 2010 year ending. Thompson Aircraft Products contributed \$463,000 to the 2010 earnings total. Gains for the year are expected to approximate \$20,000,000 compared with 1941 statements of \$45,400,000.

**Continental Motors Corp.** is negotiating with banks for a large line of credit to finance its expansion business, according to reports. On Oct. 31 the company completed the first \$100 million year in its 60-year history.

Completing its third fiscal year on July 31, Northrup Aircraft expanded sales to \$68,700,000 compared with \$34,077,000 in the preceding fiscal year while operations showed a profit of \$2,554,741 compared with a deficit of \$646,779 in 1960. The annual report revealed that a \$17,800,000 loan was obtained in August from a group of banks headed

Officers of the company were listed as: (1) To use profits to increase facilities to their maximum efficiency; (2) to hold up working capital; and (3) to establish a sound dividend policy. The report stated that the first object had been achieved and the second is on the way but the third will depend for its duration entirely upon the tax laws.

The aviation Corp. reported net earnings of \$1,071,708 or \$16.44 a share for the nine months ended Aug. 31, compared with \$1,640,445 or \$16.44 a share in the like 1982 period. At the same time sales were \$20,412,200 against \$11,075,676 a year ago. These earnings do not include the company's share in the undistributed profits of its numerous sub-

**Transit** Always is now doing more passenger business with 7 airplanes than it did last





## Winging to Victory!

### WITH "40-E" SCOTT-CAST ALUMINUM-ALLOY CASTINGS

From "Catalina" to sub-assigned balloons, Scott 40-E castings are playing a prominent role in the production of "Wings for Victory" delivered by American industry for the British in the exciting new winging aircraft program. Scott 40-E castings are now meeting every engineering and design problem in general aircraft construction.

40-E castings are exceptionally high in ultimate strength, yield strength and tensile strength. But best tested, these castings exhibit strength in 21 different stress temperature groups and it is largely credited to the production heat treatment process.

Adding strength takes place during assembly or fabrication. Due to high yield strength, Scott 40-E castings readily resist most required heat treatments. They are easily welded and are in fact bonded to steel heat treating metal. Perfect welding by the key metal volume quality of grain structure.

Production of 40-E is now appearing in mass quantities—yet Scott facilities will permit the meeting of any additional demands and in accordance with basic policy all orders accepted will be delivered on schedule.

CONSERVATIVE PHYSICAL CHARACTERISTICS OF "40-E" ALUMINUM

TEMP.	TENSILE	YIELD	ELONG.	REDUCED
32,000	25,000	24,000	18.000	4.5%

(In accordance with ASTM)

Q. S. Nitro 40-A1 Class 1 Q. S. Alloy Air Force 71424  
A. S. S. S. 71424

# Scott

AVIATION CORPORATION

SUPPLIES TO THE U. S. ARMY AND NAVY AIR FORCES AND LEADING AIRCRAFT MANUFACTURERS

ment with 18 planes. At last report, machine guns mounted in the air are making slightly in excess of just one.

Advances generally are increasing, but the production of the "Wings for Victory" is still in the hands of the machine. At the same time, the

### ON THE RAW MATERIALS FRONT

NO LOSERS will millions of Americans have to wait or suffer before they can see the wings of the "Wings for Victory" in the hands of the British. In the early days of the war, the British were in a desperate need of raw materials in plane production. Donald MacKay has entered the war to help the British. He has been in the United States since the war began and he has been in the United States since the war began. He has been in the United States since the war began.

From the West Coast to the East, the British are in a desperate need of raw materials in plane production. Donald MacKay has entered the war to help the British. He has been in the United States since the war began and he has been in the United States since the war began. He has been in the United States since the war began.

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### SCOTT Full-Swivel TAIL WHEEL ASSEMBLIES



And as another contribution to Victory joins the growing Scott family of air craft accessories and special equipment which now includes Oxygen Masks, Oxygen Regulators, In-flight Pressure Units, Control Valves, Bellows, and 40-E Scott-Cast Aluminum Alloy Castings.

Your inquiry on special equipment problems answered promptly and in strict confidence.



Scott Aviation Corp. 1000 Broadway, New York 10, N.Y.

AVIATION CORPORATION

This giant Commando glider—newest "angel" in our arsenal—Victory machine—now officially equipped with Scott Full-Swivel Tail Wheel Assemblies—now ground-bounding—more ground maneuverability.

Developed by Scott specifically for glider installations, these special assemblies are particularly designed for the standard Scott Full-Swivel Tail Wheel Assemblies. They are light, rugged and shock-resistant. These glider wheels are made by an unusual production advantage—no synthetic war material is employed in their construction. Even the tires are a special molded, composition in place of rubber!

## OPTICAL PROPERTIES



1997

1997

AVIATION, December 1962

319

### Recent Books

AVIATION, December 1962

319

PEETICK-15 is the trademark, Reg. U.S. Pat. Off., for the acrylic resin thermoplastic films manufactured by Rohm & Haas Company.

## ROHM &amp; HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA, PA.





Illustration like those are interspersed throughout the text of John G. Lee's *Engine Tests and Failures* demonstrating graphically the fundamentals of engine design and performance. Cuts show how low will support altitude performance the lightly loaded plane can rise upon it more heavily loaded aircraft.



Left: A propeller dug through the field 2000 hp. at 40 000 ft will hold 2000 hp. at sea level. Right: The bigger the "prop," the slower it will turn.

"There is an 'end' fighter engine," says Mr. Lee, the assistant director of research for United Aircraft Corporation. "With an exception, almost any 'end' will rise the same. However, if the competition is close and the opponent well equipped, then the specialist will win."

The book is an index and summary of observations of detailed tests, a manual to stimulate the specialist's knowledge in working the competition.

**PRIVATE PILOTS HANDBOOK** by A. B. Howard. Published by Pitman Publishing Corporation, New York. 280 pages, illustrations, paperback under \$2.00.

A concise educational pamphlet for the CAA office students preparing for private pilot examinations. Some compressed, pointed information on flight theory, meteorology, navigation, radio, flight conditions and tests and a list of typical examination questions.

60 answered questions for those pre-examination games.

**INTERNAL COMBUSTION ENGINES**, by J. A. Poulos. Second edition published by John Wiley & Sons Inc., New York. 340 pages, illustrations, leather binding, paperback \$1.

A comprehensive text on all types of internal combustion engines with several chapters on diesel and aircraft powerplants.

"This book," says Prof. Poulos, "is intended for junior or senior mechanical engineering students who have had a thorough course in fundamental thermodynamics and have a fair knowledge of the operation of internal combustion engines."

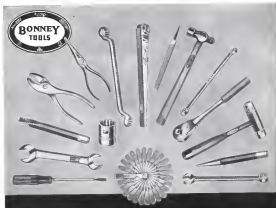
**AIRCRAFT ELECTRICITY** by Herman J. Gies and Howard E. Gies. Second edition published by The South-West Company, New York. 200 pages, illustrated \$2.00.

A text on aircraft electrical systems for apprentices and experienced electricians, designers, parts manufacturers, and engineers.

Contains performance charts, diagrams and standards for engines and lighting equipment, illustrations of circuits, wiring systems, standard layouts, bonding and shielding, and chapters on design, component selection, and inspection and protection of wiring and equipment.

#### A Correction

In the October issue of *AIRCRAFT* the review of *Practical Aircraft Sheet-Metal Work*, inadvertently stated the book was published by John Wiley & Sons, Inc. This was an error, as the book was published by the McGraw-Hill Publishing Co., Inc., 1221 W. 4th St., New York.



## For Production...Maintenance...Service

NO where—except in the Bonney Line—will you find such a complete assortment of quality hand tools for aviation production, maintenance and service.



Approved by the War and Navy Departments, the Bonney Line is the standard for quality in the aviation industry.

Considered standard by leading aviation motor manufacturers (where only quality is taken into consideration) for factory supplied tool equipment, they are also used extensively by all branches of the United States armed forces.

139 types—1160 sizes to meet practically every hand tool need. You, too, can profit handsomely by using Bonney Tools to meet your production, maintenance and service requirements—the same tools that mechanics in every line of industry proclaim to be "The Finest that Money Can Buy".

Write for big 104 page catalog showing the full line. Stocked by leading jobbers everywhere. Bonney Tools & Tool Works, Allentown, Pa.

# BONNEY

*The Finest that Money Can Buy*









# UNITED STATES AIRCRAFT SPECIAL DRILL



1/4"  
HEAVY  
DUTY

This Drill gets  
into the tightest  
places . . . and  
deserves credit  
for doing so

**MODEL ARD** The pet of the aviation industry because of its amazingly flexible use where "ordinary" drills bear no water. It's quite a handful for such a little fellow.

Universal motor, 750 to 3,800 r.p.m.; ball bearings in steel retainer, easily removed; close-coupled air-cooled switch for right or left-handed use; streamlined from tip to tip.

Easy inspection, adjust-  
ment or parts replacement

Write for details, without obligation.

## United States Electrical Tools

DRILL • DRILL STAND • VOLT-CLAMP DRILLER • Pliers

WIRE CUTTING PLIERS • NUTS • SCREWS • BOLTS • WASHERS

SCISSORS • PORTABLE LAMP • REMOTE SHOCK SWITCH

SLIM DRILLER • SCREWDRIVER • HAMMER • ROLLER



THE UNITED STATES ELECTRICAL TOOL CO.

CINCINNATI, OHIO, U.S.A.

operation slips into its flat the solution and put the new glass into effect.

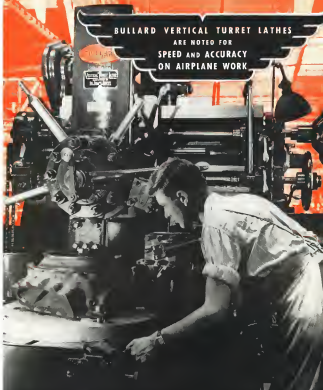
### Selling the Service

Even though the airlines come out of the war with far better equipment than ever before, with a wealth of "house boys" as expert handling and a great public knowledge and sympathy of the airplane as a means of transportation they will still have to sell their service. Solving something of the public problem to be faced and solved in the coming years of expansion the airline companies have made such errors of their way up an efficient who want to guide the shopper. This should not be a group of accidental advisers who select their business by good will and enthusiasm. It must be a group who are experienced enough to handle such. It will be their duty to explain the advantages of speed, safety, service, economy, comfort, and new markets, which drive one give the shopper. Those who can be counted on the start for new equipment and new markets. They must be an integral part of the study of operations, traffic and sales.

### New Markets

Improved equipment will result in more of the best of new commodities, but the ultimate limits will depend on good fuel on sales which will develop new markets. An airplane as it is today has already created new new markets and have will continue this process. After considerable study and collaboration with Pan American Airways, Transoceanic introduced a Latin American edition which today has a circulation of over 20,000 copies weekly and is on sale in most Latin American countries in the same way that the American edition now on sale in New York, Washington or San Francisco. Today in Buenos Aires, one can not believe and every which have had been there were the Airlines from Chile. One of the large New York newspapers has studied the possibilities of developing a speed edition throughout the United States. Chile has had up a large demand for Latin American from the United States which have been there have a new market for Latin American. The handle and delicate papers, which used to be put on such are today.

Lower, three rates, made possible by new equipment, operating efficiency and volume sales, will make it possible for the business man to find new outlets for a growing list of both essential and luxury products, orders which will help keep America's economy the best in the world.



THE BULLARD COMPANY, BRIDGEPORT, CONN.









## AIR — against WATER

Being and falling with the waves... even on a rubber raft... hazards are watched from the sea... by a thin layer of inflated rubber.

Important? Yes. It's important that the thin sheets of rubber be kept free of cracks and leaks, that the raft unfold easily, that it be safe when it's needed.

That's why rubber life rafts are processed in special air conditioned rooms... to make the rubber tough and long-lasting. Even temperature and humidity are watched more closely than air.

To do jobs like this, air conditioning equipment must be more precise, more flexible, more compact. Required "flexibility" must be a matter of both body... when needed and when not needed.

General Electric has already taken an outstanding part in developing this new kind of air conditioning for our military. After the war, all sorts of air conditioning will benefit from the lessons we have learned in meeting these stringent requirements.

More people will enjoy air conditioning because it will be more compact... more economical. Cars will have it. The planes and boats. Small stores, as well.

As large, well-tried it is, we're sure to keep such fresh. For there will demand it as we need to produce.

The place to turn for this new equipment will be General Electric... a whole new way of looking, re-designing, air conditioning, and best transfer equipment of all kinds. Turn to G-E.

Air Conditioning and Commercial Refrigeration Department, Division 107 General Electric Co., Schenectady, N. Y.

*Air Conditioning by*  
**GENERAL ELECTRIC**

### Plywood Structures

(Continued from page 149)

As are permissible due to the corrected skin thickness in the lower down section. There is, not the same weight reasons, possible in stiff and plywood shells by their stronger spacing that is found in reinforced metal panels. In the latter material small voids were an appreciable "defective" void of skin. The attention between plywood plates and stringers is a further investigation but attention at this time are that the applicable rules will be substantially different from those that are used in current metal practice.

Direction of stress in fuselage members has been largely a matter of the designers' choice. In technique of large cross section and length members at joint joints in the fuselage has led to the use of the free form in 45 deg. to the fixed line. The effective modulus of elasticity versus wall cross section will be approximately 200,000 psi for glass sheets at 45 deg. A somewhat simplified design approximation of stress is possible with this stress arrangement over the trailing edge panel has a low modulus of elasticity resistant to stresses parallel to the fixed line. It is thus not necessarily conservative to neglect the skin and to design members of sufficient thickness to resist the bending stresses as a first approximation. The skin is an area designed to carry the load. This system has been previously well known and by other test.

### The Old Shoe

(Continued from page 323)

has become world famous in the last decade, in proof of the workman of this type of shoe.

The virtues of the shoe, the United States, was the last of the model to be delivered in any other. It was turned over to TWA in the spring of 1954 and had been over 2,000,000 sq. in. a number of TWA's feet when it passed a stiff glass test examination in 1951 and became a member of Great Britain's military supply. It was then an unbreakable shoe as the day for the entire series of it seven years ago.

This is a tribute to the work of air line maintenance experts. William Maschke, air maintenance supervisor, said, his veteran master craftsmen at work of our principal stations. When these specialists have gone over every inch of a plane before it rolls up the runway for the takeoff, that plane is as perfect as though it just had left the assembly line at the factory where it was built.

## CABLE TERMINALS

- ★ All Standard Types
- ★ All Required Sizes
- ★ Millions being supplied to leading manufacturers

PN



Copies of the complete P & N Catalogue are available to industry personnel when requested on company letterheads.

**POULSEN & NARDON, INC.**

LOS ANGELES - CALIFORNIA





## Symbols

Beechcrafters are doing their part; and these are the symbols of their devotion

# Beech Aircraft

CORPORATION

BEECHCRAFT ARE DOING THEIR PART WICHITA, KANSAS, U.S.A.

(Continued from page 310)  
hauled out and emergency landing and service parts are needed. It was the lack of mobile fields which finally made our Mission, though, have automobile. That mobile field is a lot of work when you see how many of them are being disposed of planes.

### Importance of Mobility

The first air unit landing at Bongson on Dec. 29, 1943, taught us many valuable lessons, not the least of which was the need of a high degree of mobility for all service and maintenance units. During this lesson clearly in the middle of our Bongson base, Squadron Leader John Newell and Crew Chief Fox called a meeting. I was designated to appeal for help from Laos and R. J. Lewis, commanding officer of the American Military Mission in Bongson. I told him that without vehicles our ground force was unable to protect its positions, and the AVU, which was already showing its battle, would be out of the war. With the colonel's help, we eventually rounded up, first British, Chinese and other weapons, then Chevrolet Government cars, no. 150, and trucks, six Studebaker and Chevrolet tank trucks, complete with pumps and equipment for refueling planes, and six pigs.

We used the last trucks for landing communication, tools, parts and other things of that type, as well as for transporting members of the ground crew.

The communication which resulted from this move was an indication. When the air plane landed all planes, on the ship and on land, were (American) 12 men came, took off. While the planes were still landing for aircraft, the ground crew was already busy loading all materials on the field for operations on the trucks, which they then drove off the beach to previously designated disposal points.

In most instances, the squamous look of the field was, while the ground crew cleared the field in a very short time. Any plane, regardless of light, was disposed of with the trucks. If the day continued to rain, over all that day, there was a large field and when it was, they had not been hauled out yet. With the Flying Tiger as their help, it was impossible for the day to last and the situation could not stand there. No one in the ground crew ever got lost after this operation was put in operation.

As soon as the road was open, we would be back to the field, preparing for the landing of our P-51s. When we would have to fill in tank orders to get the field in shape—but at least we were there to do it.

This experience proved to my mind



## Christmas Greetings

FROM

## The Employees

OF

## The Pressed Steel Co.



**THE PRESSED STEEL COMPANY**  
OF WILKES-BARRE, PENNSYLVANIA

BRANCH OFFICES:

ALBANY, N.Y. • Gales Building • ALBANY, N.Y. • National Avenue  
CHICAGO, ILL. • Express Building • NEW YORK, N.Y. • 114 West 114 Street

**PRESSED STEEL COMPANY PRODUCTS:** Automobile and Aircraft Landing Gear, Through-hole Piston Tubes, Landing Gear Oil Cylinders, Aircraft Fuel Tank Mounts, Vehicle Alloy Tubes for High Temperature and Chemical Applications

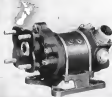


## THEY'VE GOT THE RANGE

Essentially, bombers are artillery of tremendous range (ask Tokyo) and exceptional accuracy.

Contributing to this range are Delco aircraft fuel pump motors for transfer duty, installed to safeguard the flow of fuel from multiple tanks on American bombers. Lightweight, compact and dependable, these motors conform to latest military aircraft requirements.

Similar Delco fuel pump motors driving booster pumps, are factors in the speed, climbing ability and maneuverability of our fighter planes. Delco Products has applied its long experience in precision manufacturing to this equipment, and to the building of other aircraft equipment and naval and aerospace instruments.



**DELCO** DIVISION OF GENERAL MOTORS CORPORATION

plete satisfaction that engine, maintenance of the present service equipment is so important in the success of a combat unit in its planes, when the unit is located within the bombing range of the enemy. In brief, as stated, we should forget about business and personal activities of all sorts. Your time is the first objective of the enemy, and you are bound to be hit three times or more. The answer is simple: to make your present service crew in hidden disposal plans during the attack.

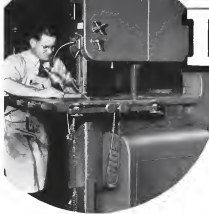
### Communications

Finally, and of almost equal importance is effective and successful servicing and maintenance in the field in communications. Accurate communications are vital during an action, to not only the base field but to the actual battle field. When this point is happened in the case of the big bomber bombing on the Japanese base, it not only requires an extensive knowledge of the successful equipment of the actual combat field, but it prevents ground crews from being prepared to perform repairs as they are the outcome of the battle. When the machine showed after the Japanese attack, it was destroyed among other things that our men were not out of action. No equipment had been built for an emergency backup to the field. To all aircraft and purposes we were isolated from the outside world. We finally asked the question, is remote emergency telephone lines from the same base location to the front line of the operational field, and we were taught the first lesson which pointed the need for machine maintenance communication means to all of the personnel parts of our equipment.

### P-40's in Burma

(Continued from page 105)

Initial airplanes caused the need to get so bad that the mechanics could not repair them. The successful the construction of about eight new shells in the field and new engine which the airplanes could be placed when it was necessary to work on them (Fig. 9). A small engine, accommodating two airplanes, was constructed in the field and was used if we need for working on these airplanes where the working had to be removed and the engine had to stand exposed for several days (Fig. 11). The repair was of single size and was used by the Royal Air Force in a base for three operations. The north south runway was 3,800 ft long and the east-west and the southeast-southwest runways were each 2,500 ft long. (Turn to page 106.)



# DoAll

at Ryan

Left—View of DoAll at work making blanking dies in the Ryan plant. A great deal of time is saved because it's not necessary to drill holes around the die outlines and laboriously file to the final contour.



### REPAIR SHOP ON WHEELS

Illustrated is the exterior of one of the U. S. Air Corps mobile machines shops used for repairing damaged planes right on the spot. The DoAll is part of the equipment of each unit.

## THE TIME STRETCHER

Wherever parts are made, planes assembled or repaired, DoAll is doing a Herculean job. Search the world over and you'll never find a machine to beat the DoAll when it comes to versatility and speed in precision cutting of aluminum, magnesium, titanium, Monelmetal, plywood, stainless steel, plastics, wood, etc.

- Cuts thick sections of any metal or material.
- Does both internal and external cutting following a lathe-like outline.
- Cuts in slots, further machining is unnecessary.
- Relieves Miller, shaper and lathe of hundreds of overworked jobs.
- Eliminates bottlenecks on regular production lines.
- Avoids shut downs of important machines by actually making new replacement parts.
- Makes special tools without dies or molds.
- Saves hundreds of man hours—cost of metal.

### Strip-Off Controller

Pat. No. 2,220,727  
Dec. 22, 1942  
New York, N.Y.



### WANT TO SEE IT WORK?

A DoAll operator will roll with a DoAll and show you how this wonder machine will aid in getting your jobs and short of schedule. ASK STANDARDS—DoAll on Production. An illustrated book you'll want to read for today.

## CONTINENTAL MACHINES, INC.

1305 S. Washington Avenue, Minneapolis, Minn.

Associated with the DoAll Company, Des Moines, Ia.; Manufacturer of DoAll Tools and Road Pans for DoAll Control Machines.

### The EXAGT SIZE for Every Department

All Models with Motors



Model 1000

Model 1001



Model 1002

Model 1003

Model 1004



**FLEETWINGS**  
Aircraft Parts  
Help Re-paint  
Another Sign...

NINE months ago, on an indication of the spirit with which Fleetwings' men and women were turning out increased quantities of aircraft parts, the company re-painted its "Defense

Plant" sign . . . changed their wording to "Attack Plant."

Today, the total of Fleetwings parts rolling off our assembly lines is greater than ever! And Fleetwings parts . . . wings, faps, stabilizers, ailerons, fuselage sections, hydraulic equipment . . . incorporated into American fighting planes, are helping to turn the "No Man's Land" on the air-fracts into "U. S. Territory."

Of course, today's vast production at Fleetwings is all earmarked for war. But for peace, Fleetwings' engineers already have plans on the drafting board. With Victory they will grow and shape themselves to help fly America to her ultimate destiny in the skies.

**FLEETWINGS**  
Incorporated  
BRISTOL • PENNSYLVANIA



The BT-13, standard basic trainer built for the U. S. Army Air Force.

credit for the first all-wooded airplane plant constructed principally of modern materials at Fleetwings for the BT-13. A host of these sturdy, aerodynamic basic trainers are now being built at Fleetwings for the U. S. Army Air Force.

THE GROUP of floor-moving production tools designed by Fleetwings' engineers continues to grow each month. None of these tools is an electric "mouse," an interesting little device to aid workers in doing extra long straight runs. The "mouse" improves accuracy and greatly reduces driving time.

ONE OF THE REASONS for the outstanding "success" record of Fleetwings-designed hydraulic equipment lies in the grading testing each hydraulic valve and jolt test machine before it leaves our plant. Valves, for example, undergo a proof test, body pressure tests, heat and cold tests, and toggle tests in addition to a check on dimensions which reject variations greater than two one-hundredths of an inch. Hydraulic hydraulic equipment is designed for use on U. S. planes on various remarkable landing gear, beach doors, wheel faps, etc.

SAVING HUNDREDS of short-cut remnants and using them systematically for forming non-critical pieces is another measure that Fleetwings has organized to help win the "War on Wastes." Time, money and effort will be saved by this policy, we are proud.

**FLEETWINGS**  
Incorporated  
BRISTOL • PENNSYLVANIA

(Continued from page 124)  
The runway had a gravel neck with a rolled gravel runway. It was made in all kinds of weather but the loose gravel was easily picked up by the propellers, and was a source of constant annoyance. The approach to the runway was only fair as there was trees on all sides except to the south.

As soon as the airplanes were lightened and all necessary adjustments were made, the headquarters of the American Volunteer Group located at Tientsin, China, were notified and they were given down to take delivery and drop them at Yunnan Kowloon. The last airplane was delivered on Nov. 26, 1941, and the American Volunteer Group pilots and their first taste of action along the Burma Road on Dec. 26, 1941.

## America at War

(Continued from page 65)

lance. A storm of harangues followed in no such for a fighting machine. The thing to look for is a machine that can destroy, destruction of his ships and his military and manufacturing works.

The air corps position has been reversed again. There is an effort to form a plan in the air corps, but the plan a few months back was to form the machine. There are no existing air planes in the corps that for the immediate future, although an early day may see the return of the permanent stage. Most of the air corps types are now in the air.

Most interesting recent development in the air is an air plane in the Army for the production of 1,000 road camp planes by Andrew L. Hughes, the New Orleans builder of coastal boats. The Hughes plant is not a new design, it is the Curtiss Wright D-7B, plus a tail, two engine, transport, roughly the size of the Curtiss D-7B. Curtiss Wright has already built this plane, and it has been accepted by the Army.

With many airfield plants closed down the lack of materials, it is still to wonder why on air to give it still another plant, which has no experience. There are many partial answers, and one of them is technology. Hughes is a man of imagination and ability who believes in the use of new things he has. It may be also derived in recently his for the construction of Liberty ships, and sold it to the Marine Corps. It probably would have worked, but there wasn't enough steel plate, and the project was dropped. Hughes has been looking to build and other kinds of aircraft for the Navy, out of pig-

iron. He makes them so much they are in no more a danger than a ship without landing up. He wanted the Navy by building a long-landing boat that others right out on land. It was probably the President himself who let Hughes have the order. Mr. Roosevelt suggested Hughes' abandoned aircraft-line shipyard, he built it as a sample of Hughes' latest most plan. It is a ship people who are not affected with security concerns.

A few notes to aid in background. The B-17 has been building and striking from some big levels, though it was originally a land-based plane. It is being out of that landing ships from high up is very difficult, because they are leaving in turn while the land is falling.

New Zealand's Army is under United States command and is being sent to fight with United States forces in the Solomon Islands.

The largest aircraft assembly base on any land is in Alaska. British air force men planes stream out of it to Near East bases. Russia does not believe that air power alone can win the war, and is more inclined to British and American begin to send groups of soldiers by destruction of Germany from sea land.

One of the largest airports in the world are now in Britain's big Lancaster bomber built on Douglas to build delight without leaving that was supposed to be evidence for B-17s and B-24s. . . . Biggest loss of the B-17s in Europe so far was three in one day. . . . 1,000 Axis planes have left their bases in Italy's north end in adjacent waters.

Counting up the total air planes on the war-torn, transport, fighters, fighters, fighters, half-ton transport, bombers, fighters, fighters, and the prospect of a world fight-juggernaut begins to wonder what we are going to do with all that thousands of planes will have and next year.

## Field Experience Back to Plant

(Continued from page 121)

representative must play an important part in seeing that the damaged aircraft are properly repaired, with knowledge in aircraft design type.

After a man is selected he is given a comprehensive, special training course at the plant which takes from two to twelve weeks. Upon graduation he is given a domestic assignment as a junior service representative, and works under the guidance of a senior service man. It usually takes six months' experience as a domestic representative before he is qualified to accept a foreign assignment. Work in foreign fields requires considerable initiative, as in many cases the equipment used which work has to be that is limited



"For Excellence of War Production"

OUR NO. 1 JOB ...

The Army-Navy "E" badge that flies over the Packard Electric factory means more to us than an award for work well done. It is a constant reminder of the work that lies ahead ... building more and more equipment to meet the requirements of America's planes, tanks, trucks and military vehicles of all kinds. No other considerations, no obstacles, can stand in the way of this vital assignment. It is our No. 1 job, and we will see it through, Packard Electric Division, General Motors Corporation, Warren, Ohio.

**Packard**  
Working for Victory

THE STANDARD WIRING EQUIPMENT OF THE AUTOMOTIVE INDUSTRY

and how it is adapted, so it is more exact and less to be feared.

Mr. Latta, having a design experience dating to the "Confined Spaces Representative League," in which all field service representatives are of varied spans of experience from the first year onward. In order to maintain an even leadership also they have proceeded to various parts of the world, however, each must master a series of questions which are drawn up every month and which must be completed and returned to the home office. In this manner the home office is able to keep a close check on the status, at field representative to handle the job assigned to them.

Each field representative returns to the home office every six months for the purpose of making field hand reports—putting up on new developments and discussing possible new assignments. These field reports, however, of problem situations are of great value inasmuch as they furnish information of their status reports, and add to the knowledge of how the field men and the home office. Because of constant effort in return reports, work is done who double their jobs, so much that each field man carries his equipment as he goes, for field assignments are not made. This provides a constant volume of reports from equipment work, for those who do not like such work, and cannot see beyond those that only completed up-to-the-minute, voluminous field representative on the ground because a complete lack of between operations and maintenance.

North American's educational program which is conducted at the plant for the Army Air Forces officers and enlisted men who will maintain and repair B-29 "Superfort" bombers in the field is also an important part of the effort to keep the equipment in working condition at the several field stations. Each month hundreds of men are sent to school for instruction of the Army Air Force, which, in turn, are sent back to operational training. Experience from the Army's work in aviation—working alone—that are experienced on a Williams-Edley basis. Many personnel, through classroom learning, and actual experience are sent to train those men whom they supervise the machine. They are the right, together with our engineers, and we are able to properly direct our own mechanical trouble and know how to correct it.

A plan is now under consideration to assign each graduate of the school to a specific airplane during its final stages of construction in order that he might travel with the plane when it is delivered, and stay with it as long as it is in use. In this way each graduate will look upon the airplane as his own. (Turn to page 422)

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### Solve YOUR Aviation Sealing Problems



Since their introduction to the aviation industry a short time ago, Presstite Aircraft Sealing Compounds have won wide acceptance by the aircraft manufacturers of America.

Especially developed for your industry—engineered to solve many of your problems—these Presstite Compounds provide fast, simple and long-lasting methods of sealing a wide variety of aircraft joints—especially in aviation fuel tanks. These uses of application speeds production—proves adhesive qualities reduce maintenance, assure satisfactory sealing under all conditions.

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A non-corrosive, non-drying, non-hygroscopic, non-polymerizing, permanently elastic, rubber-like material used as a plugging or sealing material to seal large openings in constant or static fuel tanks. Not soluble in Aviation Fuel.

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Easy to handle because in extruded form on cloth backing—varied widths.



and oil tanks. Highly adhesive to metal surfaces even in presence of liquid hydrocarbons. Non-curing, non-polymerizing, plastic adhesive.

#### Extruded Sealer for Synthetic Glass

Seals joints in aluminum as well as synthetic glass—especially designed for windshields, windows and gas inlets. Stands up under extreme low temperatures. Seals joints tight against water, air, aircraft fuel, motor oil. Permanently elastic.

#### Fuel Tank Sealer

Brush-on type for sealing integral tanks and for seams and joints in bolted tanks and for aircraft fuel storage. Will not slump up to plus 200° F., remains flexible at minus 90° F.

#### Cabin Sealer

For sealing over riveted joints in pressurized high altitude ships. Provides water and air-tight and—withstanding temperatures from minus 90° F. to plus 212° F.

#### Zinc Chromate Compound

For Conditions A and B, Air Corps Spec. No. 2246, and Shipping Compound Air Corps Spec. No. 2245.

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AVIATION December 1942

AVIATION December 1942

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# Question every fastening job...



Field maintenance begins at the place where North American exports from United States Army Air Force ground crews to service and maintain the planes it makes. In this photo it shows crews studying the hydraulic system of a P-51 Mustang bomber.

(Continued from page 124)

and test spent much in keeping it in perfect condition.

The third phase of our field service includes preparation and distribution of technical manuals. These are prepared and kept up to date. The field men from material developed as a result of the reports they send or bring to the home office. As soon as a problem is encountered and its solution has been worked out, the data is prepared for the manuals and placed in the hands of those who will need it.

In addition to the man actually engaged in the service work, there is a group of men who are little of the airplanes in action, but who, through long hours of research effort, support those on the front-line men in the service office at the home plant. These are the men who study and analyze the field representative's reports, find the answers to the problems they encounter, and get the results to the power plant, whether it be the engine house, the production line, or some point later in the chain of the other side of an area.

Members of this latter group perform a weekly service newspaper the purpose of which is to keep service representatives informed of all design changes, new methods of repair, and all other information of value that is learned as a result of actual operational experience. Some service service bulletins, complete with drawings, which outline changes scheduled for the next month in service. Orders sample records of service failures, reports on consumption of parts, and also discuss the shipment of service parts. And, finally, there are men who study and answer

the almost countless letters and reports received from North American field representatives, from the Army Air Force, and from military officials of those countries who together with the United States comprise the United Nations.

## Heat-Treating

(Continued from page 123)

about a fact in length are quenched in a special oiling tank and are removed through the quench automatically after heating. Parts which do not require special heating to prevent warpage are discharged directly into the quench when the length of the furnace is filled. These furnaces, with all others and, are equipped with automatic thermostat control for maintaining the temperature set with the particular part being heated. Parts which require quenching are heated through an Apex salt bath furnace equipped with electric for heating. A water tank, in one side and an oil tank at the other side of the furnace are arranged so that either may be used for quenching. Parts heated through this furnace are heated to about 1,500 deg. F.

Most parts which are hardened automatically have to be passed through two furnaces of which size of the pre-heated tank type are provided. Parts to be placed in these furnaces are put through a vibratory-type depressor after oil quenching and are heated into trays and baskets handled by a custom overhead bridge crane. Products of combustion provide a substantial temperature and are continuously exhausted through the hatches of parts. Distortion temperatures range from 360 to 1,200.



Wiry Joe, long a leading manufacturer of replacement wire and cable for the automotive industry, is also an important source of supply for aircraft wire and cable for the aviation industry.

The Wiry Joe "Aviation" line covers everything from standard cable, high-tension cable, primary cable—original or replacement—Wiry Joe also manufactures welding cable.

Every Wiry Joe "Aviation" cable is a quality cable, built to meet even the most exacting specifications, and produced under the Division Method of manufacturing for high efficiency, long life, dependability and economy.

Figures concerning wire or cable for any type of service will be promptly furnished.

## Wiry Joe

### AVIATION CABLE

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#### Lifting Cable



#### Two-Conductor Cable



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#### Starter Cables



See Wiry Joe's complete line of aviation cables and equipment.

## Wherever You Can Use

### P-K Self-tapping Screws You Can Save Time-Consuming Operations!

It has never been claimed that Parker-Kalon Self-tapping Screws offer the best means of making every fastening under all conditions... not, it is a fact that, for a very large percentage of metal and plastic fastening jobs, these famous screws offer a combination of ease, speed and security that no other fastening device can exceed on a small scale!

#### New P-K Self-tapping Screws Simplify Fastening Jobs...

One easy operation makes a fastening with P-K Self-tapping Screws... merely drive the screws into clean untapped holes. Such simplicity obviates tapping and tap maintenance... solves the problem of getting loose taps... stops fumbling with bolts and nuts and placing of lock washers... does away with inserts in plastics... cuts out grinding and welding in hand-tight-at places.

Shed now... question every fastening! Be sure you can't employ the simple Self-tapping Screw method before you put up with a more difficult one.



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Call in a P-K Assembly Engineer to check over fastening jobs with you. He can show you how to search out all opportunities to apply P-K Self-tapping Screws. And, he'll recommend them only when they will do the job better and faster. If you prefer, send us assembly details for recommendations.

#### Change to Self-tapping Screws Over Night...

No matter what material you're working with... light or heavy steel, cast iron, aluminum, brass, plaster... you can adapt P-K Self-tapping Screws to advantage. And you can make the change-over without interrupting production. No special tools or skilled help are required. Parker-Kalon Corp., 152 Varot Street, New York, N. Y.

**PARKER-KALON**  
*Quality Controlled*  
**SELF-TAPPING SCREWS**

Give the Green Light to War Assemblies

AVIATION, December, 1942

127

# HOLOPHANE

*The Most Respected  
Name in Lighting  
— Since 1898*

Under the pressure of emergencies and in the midst of material shortages it is wise to remember that basic fundamentals as applied to lighting do not change . . . Control of light to provide proper visual conditions is as dependent on scientific principles today, as ever . . . And today, as ever, Holophane continues to operate on the principle that good lighting begins with good engineering . . .

**TODAY—Wartime Performance . . .** With 85% of all productive effort directly relying upon light, the value of scientific lighting becomes a matter of national importance. It is significant that Holophane equipment is being installed in an ever-increasing number of important military, naval and aerospace projects.

**YESTERDAY—Scientific Principles Tested . . .** For more than two generations, Holophane equipment has contributed many major advances in lighting technology. Many protection and accurate operation brought the development of many new Holophane lighting units, each designed for its specific commercial, professional or industrial usage. These units are serving effectively, economically in every phase of our nation's life—in schools, factories and hospitals, on highways and airports . . .

**TOMORROW—Research Based on Experience . . .** Since the bare structural elements of Holophane units are clear protective glass, their maintenance requires a minimum of critical attention. This fact, along with the constant research for new equipment provides an even more vital part, in the war program, for Holophane Planned Lighting. It saves materials, electric current and manpower. It conserves waste into weapons. In future it will continue associated with the effort for victory.

We have contributed to and are continuing with the War Production Fund to Quicken Resources



Holophane Engineering Service offers, without charge, consultation and recommendations as to the safest, most efficient, most economical illuminations of your premises . . . If you for the latest Holophane Bulletin "Lighting for War Industry"

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60.2° F. depending upon the particular "heat-to-light" ratio desired with the given fixture.

Other basic data among the most important points listed listed. They are made from vacuum seal taking and, after undergoing single annealing, are given a stress release by heating in air for hours at 1,200 deg. F. in the dark, then, after which they receive further annealing before hardening, which takes place in 16 minutes inside a furnace at 1,400 deg. F. during which they reach a temperature of 1,500 deg. F. before being quenched 300° dropping the heat to about 1,100 deg. F. for two hours and are then cooled to air before they receive final annealing.

Consequently, made from a special annealing steel, are handled in a separate room at the department. After such has been, the large pieces are slowly cooled during which they are heated in a special furnace for six hours at 1,100 deg. F. and then cooled to air. After further annealing, which is not effected in the furnace, the materials are given a special stress relief for the same time and at the same temperature. Then the shells are ground and polished all over and the design is etched plated before annealing takes place.

There are six Westinghouse striking fixtures, each capable of outputting 20 candlepower, which are carefully heated in the furnace in a special rack along with a steel plate cut from each design. When ready for annealing, this to enter the furnace is lowered and heating is an atmosphere of nitrogen gas takes place. A temperature of 100 deg. F. is held for 45 hours after which the charge is cooled to the furnace to 250 deg. F., the total cycle requires 60 hours.

Once the five fixtures become the materials are given long-term tests on 300 percent of the price; and the same applies to similar fixtures and to more advanced types. Some 20 percent of other parts which have undergone heat treatment are similarly tested. Shaded two-in. units on the smaller parts and Russell units on the larger ones. Before annealing, the parts are placed with steel stock in steel plate in a Westinghouse of one half inch in surface diameter are in evidence. Parts which have been subjected to heat are placed in the furnace at 1,400 deg. F. for two hours and are then cooled to air before the parts are annealed and released by the manufacturing department.

All elements include both and cylindrical. Shells are put through a furnace in which they are subjected to stress relief in heating for six hours at 1,100 deg. F. The steel furnace is a constant one type steel with internal gas and (June to page 311)

# Infinite Positions

WITH NEW SELF-ADJUSTING PEC JIG CLAMPS



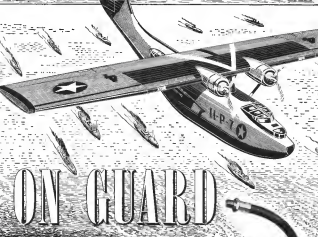
No OTHER CLAMP is as flexible in its applications . . . in closed position, the clamping bar has infinite adjustment up to 15° below and above horizontal . . . yet you can't shake open the new PEC drop forged jig clamp. Because of the exclusive PEC self-adjusting feature (which operates like the slotted ap-

erture on a pair of pliers) it is now possible to carry a much smaller stock, as one PEC is adjustable to do the work of many ordinary non-adjustable jig clamps.

Write today, outlining your requirements, and complete information on this new PEC jig clamp will be rushed to you.

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## against Vibration, Varying Pressures and Extreme Temperature Changes WEATHERHEAD FLEXIBLE HOSE

BUILT to meet the toughest service demands, Weatherhead High, Medium, and Low Pressure Flexible Hydraulic Hose assemblies keep hydraulic forces flowing to vital mechanisms on every type of military and commercial plane.

Withstanding heat, cold, vibration, shock, and varying pulsations of pressure, Weatherhead assemblies are used for fuel lines, oil lines, instrument lines,

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Fine contacts with the Army, Navy, Marines, and Coast Guard are evidence of the reliability of Weatherhead.

Other Weatherhead airplane accessories include Dual Tube and Pipe Fittings; Vacuum Selector and Check Valves; Hydraulic Check Valves; and Hydraulic Actuating Cylinders. All are manufactured to Air Corps, Navy, or "AN" specifications.

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engaged with a machine. It requires gearheads on all engines except for landing and unloading the cargo. As the fuselage is but 20 ft. in length, the conveyor system about 20 ft. in diameter and it is a very simple matter to load and unload cargo from end to the short work on which they are delivered.

### World Cargo

(Continued from page 117)

weatherhead facilities. In setting up a worldwide engine system, the vast distances involved when operating over such clouds have required that the planes be made to operate in and out of airports which were often little more than stretches of road.

We soon found that perhaps the greatest single aid in maintaining these airplanes was to provide, as quickly as possible, uniform means for landing, taking, and taking off. It is obvious that in the operation of combat airplanes there is very little leisure for choosing airports as a matter of convenience—make the case of fighting planes in the African desert, which need be expected to operate from the first of the desert itself.

The first part of the plane to suffer was the engine. Good reason for the station of the propeller, or landing up from the landing gear, an island or landing, is there about directly into the engine room. Before the development of carburetors for turbine engines, it was not uncommon for an engine to be completely "grounded" by use of the turbine and compressor within 10 hours of operation. Failures of two main types have been developed with running and non-running failures. It is obvious that power loss must be expected when using a non-running type, driving the turbine air in from behind the engine making instead of moving the full pressure of the forward air flow. However, the inherent reversibility of the turbine themselves has been found to justify the present installation toward the use of non-running failure. This is not always true at the rate of the fuel that the air flow is usually only necessary as a backup and backup, and the length of run available is usually not critical in the desert. The real problem comes with altitude, at which point the intake of air for the carburetor is restricted even to the usual inlet taking around all the landing edge of the crest.

Protection of the engine on the ground is also of extreme importance to achieve the maximum engine life. We quickly found that it is not safe to use an engine without fuel, or even an engine about length of time, as such desert fields, without thoroughly con-



## A HIGH - SPEED KEYING BREAK-IN RELAY

Emergency battery  
operation with  
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Working battery  
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Without consuming  
5.5 amp power  
(1.5 in. space)

Key at 25  
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withstand  
to better than  
10:1

Temporarily held  
to help prevent  
burns, does not  
relax on long periods

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high pressure  
station

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terminal points  
available

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Volts, 25 megacycles  
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1.75" x 2.0" x 1.0"




● Add a compact, high - voltage, high speed, non-vibration type keying relay for break-in operation to aircraft radio equipment. A push-pull magnetic arrangement which provides magnetic holding pressure on both transmit and receive contacts. One pole is equipped with two windings, one of which is a holding winding connected directly across the battery supply. The other winding is connected in series with the single winding on the other pole and polarized so that when the circuit is completed through the key, the flux is concentrated on the holding or receive portion pole and the armature pulls up to the transmit position. Opening the key cuts off the holding flux and the holding flux pulls armature back to receive position.



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# REX-FLEX

## Stainless Steel Flexible Tubing

SIMPLIFIES AIRCRAFT ASSEMBLY...  
MAKES TOP PERFORMANCE DOUBLY SURE



Many types can be used for aircraft assemblies.

Rex-Flex Stainless Steel Flexible Tubing combines the high fatigue value and the heat and corrosion-resistant qualities of stainless steel with extreme light weight and flexibility. Rex-Flex is bendable in multiple places, available in long lengths, and can be "snaked" into place in cramped installation, eliminating joints. Rex-Flex also speeds up installation of fuel ducts, exhaust connections, blast tubes, heater ducts, power plant accessory parts

Rex-Flex Stainless Steel Flexible Tubing is available in five wall forms, all of which can be combined in a single one-piece length, with straight walls and corrugated sections at desired intervals. Sizes 5/16" I.D. to 5" I.D. (exclusive). Made of 18-8 (Austenitic) Stainless Steel. Fittings are attached to tube ends by nuclear resistance seam welding. No flares, no crimps, no quenching—positioning absolutely tight, homogeneous assemblies.

REX-FLEX is a production item designed to meet certain requirements of industry or power. Fortunately REX-FLEX, as well as our other established Flexible Metal Hose products, have proved vitally important in our country at war. REX-FLEX is offered as a typical result of the engineering, initiative and productive resources of this company. We welcome further tests of our ability to meet your services in your needs.

## CHICAGO METAL HOSE CORPORATION

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effing agencies which lead into the engine, as these need doors are known to be hot with such a fire starting engine. A hose may go in to back without passing over the engine or over the exhaust as often, and refers to that the need blowing and when at that in the neighborhood.

This also applies to engine having the net "blast" exhaust angles, where it is possible for the aid is then directly into the cylinder exhaust ports.

When there is the last likelihood that and you on the way, Douglas found that the exhaust position is in detail engine cases (covering the perforator doors also and extending back over the exhaust outlet) and point the engine over the wind.

Experience with a particular series of operations just also shows that it is necessary to get on the danger, get and Pileup comes to mind has on, the workable thoroughly tested in the long run.

In spite of the previous applies the maintenance crew can expect that after each "blast" it will be necessary to go back into the shop for a thorough cleaning. It has been found that these doors and windows, probably.

At a trial of the past experience, special provisions are now being incorporated to meet fully pointed in double type from the various at foreign matter.

With that, maintenance on a one or get to be a small table to carry "rotation" but installed over the exposed surface of hydraulic shock absorption, strike and a large in large pipes. These over the dual purpose of catching dust from the interior of the hydraulic cylinder, maintaining the oil, and of preventing the shoring and destruction of the pipes, and the parking themselves. It is well worth while for service personnel, under normal conditions, to make up their own mind, to check their own calculations and to patch up the holes that are not good from their, such as rough handling.

On the U.S. transport, Douglas is now using an engine with the four important mounted on the same section of the engine. From the service standpoint the requirements a distinct improvement in accessibility, but it has also been proven, for the same reasons to our particular thought in working on the engine. The increase of being able during transport time has accelerated particularly over the working these units against vibration. Development of an "engine" structural system for the aircraft itself is now being carried on. Elimination of the engine, now, and to shift the engine and wing wing will make this (Part in page 222)



## RADIO SERVICE MAN OUT OF Cairo

Somewhere in Africa... or Iran, India, China... an American headgear returns to its base. Tomorrow, it will be again... provided essential repairs are made tonight.

For this and numerous other such situations, BENDIX RADIO Service Men are ever alert. Stationed at such

centers as Cairo, Karachi and Kanton, within reach of advance bases of United Nations forces, these trained engineers are available at all times to render expert services. Here on the home front, too, men and women of BENDIX-RADIO are doing their best towards victory.

Products of BENDIX RADIO are approved members of The Institute of Radio Engineers and equipped with 35 bench prime line units in Great Britain and spreading to our flying school in World War II.



BENDIX RADIO BENDIX RADIO DIVISION



THESE mischievous miscreants seize hold with pilots' nerves, chattering sleep, using misdirections, playing tag among the instruments, and generally causing vicious outbursts of their mysterious selves.

One place they haven't been so successful with their mischief, however, is in the radio instruments, mainly because of Flexible Low-Tension Shielded Cables that won't permit their sly whisperings and those distracting and interfering radio

induced noises to get to the pilot's ears. With the help of protection of Flexible Low-Tension Shielded Cables, United Nations' flyers hear their radio signals and directions clearly, unafraid.

American Metal Hose makes a complete line of fittings and accessories for American Flexible Low-Tension Shielded Cables. Both fittings and cables conform to A.N., A.C. and NAF specifications.

# American Metal Hose

AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS COMPANY • General Office: Waukegan, Ill.  
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wiring work were available for the maintenance crew. However, some of the problems in connection with the open system change are not quite complete.

As we mentioned above, extremes of temperature are hard on rubber, and the heat and humidity of tropical operations definitely shorten the service life of rubber hangers. As a matter of fact, we found that the cheapest, by heat, of spare hangers to correct tropical parts where the heat rule might be a month or two, would deliver most of the hangers with half of their service life exhausted. We found that an investment of such parts was justified to insure a reasonable life after installation on the planes awaiting them.

The elements aside about replacing thermal expansion will also apply to seals in tropical operation. It is to be expected that hydraulic fluid, heated in various parts of the system, will expand during the temperature change from the end of the morning to the heat of the afternoon. It is necessary for maintenance men to check this carefully, and if necessary replace the pressure to avoid undue strain on dual lines or hydraulic lines.

The effect of heat on Plexiglas surfaces is already quite well known from experience in southwestern United States desert areas. Under temperatures ranging to 175 deg., the expansion of Plexiglas in the larger panels causes it to bulge and take a permanent set. On some of the biggest panels the Plexiglas may even sag around spars under its own weight, if not properly reinforced.

This condition can best be alleviated during maintenance by leaving windows open for ventilation within the airplane, so that the Plexiglas will not get so an even with the hottest air along the top near the Plexiglas. In addition, it should be remembered that any dark cover, such as canvas, placed directly on the Plexiglas will greatly increase the heat absorption, making the adjoining Plexiglas even hotter. Fortunately, the outside temperatures usually drop somewhat during a mid-afternoon.

Considering the low temperatures which we have mentioned as common during the winter months, it is not difficult to remember the plywood problems which resulted from contracting all metal airplanes in tropic and sub-tropic areas. Imagine having a scratch cut in the rim on the hottest summer day you can remember. Push it up and burn your fingers, and you will understand what the skin of an airplane feels like sometime after eleven o'clock in the morning under these conditions.

At the present date, the scope of op-



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Increase efficiency of employees.



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FOR THE ASKING

THIS INTERESTING DATA BOOK HAS ALL THE ANSWERS

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## HOW TO CUT OUT AN AIRPLANE WING



Above: Cutting out wing section in an aircraft plane with the Quickwork Rotary Shear. Trimming airplane wingtips is fast, accurate with Quickwork No. 4 Rotary Shear.

## OR TRIM A STAMPING

For accurate shearing of stainless or dural plate . . . for speeds up to 40 ft. or more per minute—use Quickwork Rotary Shear. This versatile machine actually does the work of seven machines—sawing, shearing, saw, lathes. Operations include: cutting straight lines, narrow strips, circles, irregular shapes, flanging, and joggling. Available in 12 standard models . . . capacities up to 1" mild steel.

The Quickwork is widely used in the making of parts for airplanes. For information, write

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The Aviation Industry Is Served By Whitling Corporation with Cranes • Tools • and Material Maintenance and Handling Equipment.

mechanisms, in which the airplane is subjected to a precession motion, we have noticed that their maintenance inspection is required, for instance, on the tail section assembly. Hence, if that particular airplane is operated at those low, yet great, in-circuit vibrations. This time also has a considerable effect on such as the propeller system, where failure of starting handles and fittings have been known to occur much rather than should be expected, materials in increased vibration in the use of an in-circuit power and spin conditions. It is, therefore, questionable at times whether power output should be chosen to obtain the most reasonable fuel consumption, or should be increased somewhat to avoid under maintenance costs, because of increased vibration.

We are sorry to say that we have noticed that one of the most neglected items, affecting the service life of the propeller, being operated ahead, is proper attention to the engine. Loading them, as indicated in the past, have been more complicated than is desirable for even use, and considerably effect has been put into providing the loading data in a simple form. However, it is imperative that ground crew understand the basic limitations regarding engine loading for the airplane they are loading.

When loads for the fuel and oil balance of an airplane expressed in percentages of the mean conditions should have been established, just how seriously issued by experience that these limits can be exceeded to a serious degree without apparent danger. This has led to a host of problems of loading engines in an airplane in flight. Assuming that the steps "look good," it is also. Reverse of this, quite a few airplanes have gone through the same as noted of leaving the airport. Since the ground crew doesn't want to see that airplane left hanging on the fence at the end of the field, it is extremely important that they give careful consideration to how much of a load they are putting in an airplane, and to ensure that the load is placed within the specified limits of CG location.

Maintenance men have found for instance that if an airplane is constantly loaded with the CG "just a little" off of specification, they are going to have a lot more trouble with standard vibration fittings. The pilot may not see this substance with a 5 or 10 deg of elevator trip, but that only means that the tail group is subjected to a preloading, shortening its service life, because the ground crew did not properly balance the cargo.

Long-range flights have also brought

## A LIFESAVER for the aircraft mechanic

Now the starting device automatically grounds the magnets when engine are disconnected



This dual magnet grounding plug guards the lives of the ground crew mechanics as they swarm over a plane during service and repair operations. Without such a safety device, any movement of the propeller might accidentally start the engine with tragic results.

With this Cannon Plug it is not necessary for anyone to remember to ground the magnet after the engine circuits have been disconnected for servicing. This is a typical example of how Cannon Plugs are used for a wide variety of applications in aircraft and other fields.

## CANNON SERVES MANY INDUSTRIES

Cannon precision-type multi-contact connectors are made in countless shapes, sizes and styles, and are backed by twenty-seven years of electrical specialty manufacturing experience. They have become standard equipment in radio, television, aircraft, motion pictures and countless other fields.



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Cannon Electric Development Company, Los Angeles, Calif.

Canadian Factory and Engineering Office: Cannon Electric Company, Limited, Toronto, Canada







## READY FOR DUTY IN ARCTIC COLD— IN TROPIC HEAT!

Today—flying in all the world's climates—the Army Air Corps demands Radio Phones that will function perfectly everywhere . . . in the frigid air of the stratosphere . . . in the blazing heat of the desert. It's no easy task to build sensitive instruments for such a temperature range!

Murdock Precision-Built Radio Phones meet Army specifications. They are standard equipment with the Air Corps wherever it fights.

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**MURDOCK MANUFACTURING COMPANY—Chelsea, Mass.**

pleasant to use how quickly American mechanics and field personnel have shown themselves capable of repairing in Tundra currently an obvious problem formerly nonexistent under the facilities available back in the United States.

The subject of spare parts for maintenance of airplanes should hardly ever really deserve a separate book to itself. We should like to mention here, however, that if we expect to keep "the Flying"—that the spurs out to the corners who need them? The comparatively wide variety of the models is being produced by this country, has been the subject of considerable discussion. However, that variety requires that information on interchangeability of parts must be supplied to crews and mechanics in the field. As an true handling several models of airplanes may not have available a useful replacement part of the particular part number for that airplane. An aircraft part, or one which may be used in its place, may exist under a different part number for this airplane. If these mechanics are not informed regarding the absolute interchangeability of such parts, errors and delays are inevitable. It may be expected that replacements will be ordered from the main base or from the factory, when a part is already available which could have been used. On the other hand, without such information on interchangeability it is possible for field crews to substitute a part which "looks just like" the one desired but which should not be used, perhaps because its strength is less than that of the correct part, or perhaps because of some functional difference not easily seen.

Mechanics men will be glad to hear that Douglas and other manufacturers are placing increasing emphasis on the consideration that interchangeability means interchangeability. We certainly hope that improved solutions of these problems are contributing to the ease and faster maintenance of our new airplanes.

The next few years will certainly see much more action into the extent of "round the world" air transport. They are off to a flying start and the initial efforts of maintenance men, pilots and mechanics, should be such to contribute to the best effectiveness of these United States contributions to the far-flung United Nations supply line.

### Wasp Power

(Continued from page 107)

Now, Valley, Deluge, is doing everything. All these are doing work, or preparing for it, that is almost identical with that done by their kinsfolk. In our last



## HOW OPTICS SERVED A CHEMICAL PLANT

**A** troublesome operation in a well-known chemical plant was the reading of inaccessible gauges. Every twenty minutes an employee would climb a fifty-foot ladder and call successive readings down to the control board below. Today all these measurements are taken remotely by the engineer on duty, without leaving his chair and with far greater accuracy. Control has been greatly improved, unnecessary time and labor eliminated. This improvement was an accomplishment of advanced optical design and manufacturing, a typical example of how Perkin-Elmer engineers can improve industrial efficiency. Frequently the existing source of optics can "lean up" with chemical, mechanical or electronic methods to provide the answer to otherwise insoluble problems.



Despite the fact that The Perkin-Elmer Corporation facilities are and will be devoted entirely to the war effort for the duration, we shall welcome your letter describing present problems or future plans. If we can be of service now or in the future, we shall be glad of the opportunity.

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Improved special compounds perfected for faster, more efficient cleaning of steel.



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Approved Aero Compounds

Designed for fuel and packing tanks in the building of airplanes and ships.

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experience with money we have discovered that most women prefer to do work similar to that done by their husbands, brothers or fathers.

Included in our current members classes, of course, are many men, some of them recruited from the ranks of former garage mechanics, some older men, and many from other industries but who have chosen mechanical studies. In addition to actual shop work, they too attend classes where they study engine equipment, mechanics, tools, techniques, and all other phases of the work they will do.

When the full story of this period can be told, it will not be a story one of unbelievable expansion of hours flown, tons loaded, or routes pioneered, but will also include a chapter on maintenance that will cover some of the toughest problems the authors have had to solve. And not the least of these will be the replacement of manpower with stamping in the shops.

### Aircraft Maintenance War

(Continued from page 118)

a completely equipped repair and overhaul shop for the handling of 33 types of aircraft, plus seaplanes, motors, and propellers.

In three months time all equipment, materials, plus a personnel of several thousands, had been concentrated and shipped to the site of operations, and in another month preliminary operations had begun. The line is now handling production quantities of aircraft, engines, propellers, and all the related equipment required to keep our aircraft flying. This miracle of organization and construction speed has been repeated around the world in the past year.

Maintenance bases generally fall into two classes: (1) Depot groups providing the various mobile type of overhead, and (2) the heavy permanent supply depots. Because the developments of war are being accelerated the depot groups must be completely flexible, ready for movement at any time. Since our centers were designed on our AAF for all major operations, and since the AAF had necessarily depend upon precise and reliable maintenance, the movement of maintenance equipment and parts is of the utmost importance in any other line of supply serving our fighting operations. Controlling the movement of our Army aircraft in the mid Air Service Command, which in 1941 was called the Maintenance Command. Now under the direction of Maj. Gen. W. B. Frank, the Air Service Command responsibility has been assigned out of the seat. (To be continued page 117)

**Cecostamping**

*Explosion door of aluminum alloy made in a 60" x 50" Cecostamp*

*Half an air plane motor and four frames made in a 60" x 50" Cecostamp*

*Explosion door of aluminum alloy made in a 60" x 50" Cecostamp*

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CECOSTAMP  
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The modern stamp for difficult forming of high strength steel and aluminum alloy deep metal parts.

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CHAMBERSBURG  
PENNA.**



In addition to the factory schools, Lockheed has built Technical Training Command schools training tank crewing of completely equipped tanks carrying loadings of all operating systems of the aircraft and designed to simulate from squadrons to squadrons for training needs. These units are supplied with Lockheed and AAF instruction, and there a great number of the problems arising in the operating squadrons may be attacked on the spot by reference to the Technical Training Unit.

Other schools have sprung up

throughout the country, including various detachments of maintenance mechanics, and the men attending them have been found both eager to learn and of high caliber. The supply of trained personnel required for maintaining our aircraft is being promoted. Now is that persistent problem of transportation of required parts and technical personnel to distant bases across the sea. There was a task of huge proportions—but it is being met very ably by the Air Transport Command. As the Transport Command's fleet of aircraft grows, the

problem of air-ways maintenance develops, because through the operation of these fleets of aircraft we are able to deliver to our fighting squadrons the parts, information, and personnel they so urgently need. Fast is that the Air Transport Command operates the greatest airline on earth, and it grows day by day.

The production operation has tapped the vital and constant fund of experience available from the nation's airlines. We are added fortunate that our first engine system had progressed to such an advanced point prior to Dec. 7. This fortunate world of experience has enabled our larger transport system to expand its trips and loads where otherwise a lengthy and costly period of training would have been required.

All of the foregoing activities are being welded into an integrated whole to keep our aircraft flying. A vital aircraft part is Australia's limited resources to China, a nation problem of fuel in England, or a set of aircraft parts to South America! These calls testify some of the problems which find the Air Service Command duty. Their problem must be dealt with accordingly, analytically. Each requires close cooperation and consultation of efforts of our various Army Air Forces Commands.

The fundamental maintenance problem of war are probably no greater than those which would confront us in peacetime if we were operating in the domain of Libya, the western-based Americas, or the jungles of New Guinea. It's just that these problems are magnified to the nth degree by the requirement that they must all be done at the same time and that their strict execution is demanded by the compelling double-headed urgency of expediency and security.

Lockheed's overseas bases, the first of which was established more than two years ago, are affording our engineers a source of vital information which will enable us to build more durable, maintenance-normal. This vital fund of experience cannot fail to aid us in making our fighting aircraft more formidable and reliable to men, designs come from the factory.

Lockheed has placed field service representatives in every one of the United Nations where Lockheed aircraft are flying. These representatives, in touch at the factory to contribute technical ability and knowledge which will help keep our aircraft in the air. As a matter of fact, these men will push us and help us on new aircraft, problems of maintenance.

At later West Coast locations, Lockheed and Vesp combine on experimental (Turn to page 311)




## An Engine Stand That Meets Every Requirement of Full-Speed, Full-Time Production

Designed for use with interchangeable mounting plates for radial engines, this stand has an entirely enclosed gear drive and adjustable air brackets which make it easy to obtain the center of gravity on a wide range of engines. Speeds, compression, servicing and overhauling. Equipped with friction floor stop, removable oil pan, steel ball bearing chassis. Write or wire for descriptive literature on our complete line of stands for aeroplanes and tank engines.

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# Power

LIGHT WEIGHT DESIGN



**POWER THAT WILL HARDEN, FASTER, FASTER—** that's Diesel Power! And that's the power that America needs and is getting from the Gullerston Radial Diesel Engines to help the disintegrator and power the Air. Gullerston Diesel for tanks and aircraft are weight less than 2 pounds per horsepower.

**POWER THAT IS SAFE AND DEPENDABLE—** that's Diesel Power! More than 18 years ago the first A.T.C. installation for a Diesel engine for aircraft was used in a Gullerston. The use of Diesel fuel eliminates fire hazard. There is no ignition system to cause sparks or to start with with safe operation.

**POWER THAT COSTS LESS AND CURES MORE—** that's Diesel Power! Giving 30% more power per gallon of fuel (and less cost than to check in equivalent powered piston engines, Gullerston operators costs are extremely low. The full range range of the Gullerston keeps maximum power flowing at all operating speeds.

54

AMERICA'S AIR-COOLED RADIAL DIESEL ENGINE

ESTABLISHED 1910

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Dallas, Texas Aircraft and Motor Division



CONSOLIDATED CORONADO

## Destruction must arrive on time!

The luxury of a second guess is seldom afforded in battle. That's why on-time arrival of critical war materials must begin on the production lines and carry through to the attack. Men and women production fighters at Rohr are teamed up

with the battle forces of the nation on every front where Rohr-equipped planes fly. Day and night, seven days a week, Rohr workers fight - not to meet, but to beat production schedules ... to help give America more planes faster.



**ROHR**  
**AIRCRAFT**  
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HELPING TO WRITE THE STORY OF TOMORROW



"It isn't the individual nor the army as a whole, but the combined resources of every American unit."

—General Hap Arnold

manufacture laboratory, in the form of a service shop where repairs and overhaul methods are developed to speed operation in the field, where new types of tools and jigs are built, and where the various rubber equipment required to service aircraft is developed and proven. It was here that the mobile maintenance units were manufactured. The trained men who man these units in the field were another important product.

There you have the pattern of the military, complex endeavor, each of which contributes, in its own way, to the maintenance of an aircraft. All of the commands of our Army Air Forces and all of the manufacturers of our aircraft, engines and parts, of instruments, are working together in a grand team to help our model fly—“over the hill.” Speedy work is a determined man, effort secures the attainment of our ultimate goal—Victory.

### Standards Committee Program

(Continued from page 185)

Standards Committees met in St. Louis and let down a lot of hair. There were many differences of opinion, but little or no reason, except perhaps that the several engineering organizations had never before tried to work together. There was a period of sitting separately which obviously was not the advantage of a permanent working group. Now that the representation is fairly fixed, with few personnel changes, the committee knows the habits and methods of the member companies, and the solutions are somewhat expedited. This advantage should be better understood.

The latest part of the committee is one of fifteen by its own designation. The subject is now, and the general concept of “hangarhole” or something “there” is design has permitted much constructive standardization. Actually, a standard does not freeze or limit development of a design, but simply holds one part stable for a period while a new principle is developed in another. That is a major point for education which should be emphasized in every engineering class.

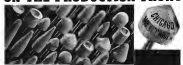
The present status of the committee shows a fair amount of completed standard work in a large size. There are over 100 standards completed in over 20 subjects. These are available to all industries without cost, at the Office of the National Standards, NBS, one of the Aeronautical Chamber of Commerce, Standards Building, Washington, D. C., or from the Government. Personal requests for standards should be for sheet, hole, tube, rivet and structural shapes in both steel and brass, plates, bars and gages of inch

size, wire sizes, threads, wire, thread pitch, rolling tolerances, control rod and cable fittings, standards for surface roughness or surface finish, low tension electrical cable, bending, hydraulic fittings, electrical resistance welded methods for dissimilar materials, high strength bolts and nuts, steel-cement fittings for pipe lines and valves, etc.

There are a number of Army, Navy and standard Army-Navy standards for pins and prefabricated materials as well as a fairly complete set of standard specifications. Most of these

are being practically revised to keep up with the rapidly changing material situation, and in this line is an interesting liaison between the members of the Army-Navy Aeronautical Council, the NBS, the Aeronautical Engineering Board of the War Production Board and the representatives of the industry and manufacturers. One national membership. The international standards, already completed will effect a simplification of design practices as well as manufacturing and procurement. Interchangeability of raw materials between plants of prime and subcontractors is a major problem.

## CALLED FOR ACTIVE DUTY ON THE PRODUCTION FRONT



“We have a new job—keep grinding going full blast all over the country in every way industry — in machine shops, tool rooms, experimental laboratories, repair shops—everywhere.”

### ATTENTION!

Our complete facilities are now devoted to making CHICAGO Mounted Wheels and Modified Grinding Wheels 3 and 4 inch in diameter. We're proud to be given this definite and important part in the War Program. We want you to get right and do everything that will aid for Victory.

Send us your promptly ordered for mounted and unmounted grinding wheels up to 4 inch in diameter 1 1/2 inch diameter.

We'll get the right wheel for the job you want it. We're going to have it done right on your customers (many of whom have been with us for half a century) on this order for Mounted Wheels and 3 and 4 inch in diameter.

Specializing in high production of Mounted Wheels, Cut-off Wheels and small Modified Grinding Wheels will be our job until the war is won. We know you will understand.

TOO SLOW? HAVE OUR NEW CATALOG—It shows in actual photos and words the most complete line of Mounted Wheels made. Send for copy today.

### CHICAGO WHEEL & MFG. CO.

America's Production Line for Mounted Wheels, Grinding Wheels, Cut-off Wheels, and small Modified Grinding Wheels will be our job until the war is won. We know you will understand.



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CHICAGO, ILLINOIS





## AIRPLANE WHEEL OF MAGNESIUM (Continued)

BY

*Wellman*

★ This magnesium casting—from a sand mold—although intricate, is smooth, clean and precise in every particular. It is typical of thousands of other Wellman castings in other metals and alloys as well.

Thus is the result of an exceptionally well trained personnel—men who are accustomed to maintaining a fine degree of accuracy so that the castings may have that precision so essential in the aircraft field.

This expertise in casting is followed by thorough inspection—with X-ray. Here is the final test in which the X-ray is reliable and available.

It is worth a lot to have quality—and be sure of it.

Castings in brass, bronze, heat treated aluminum and magnesium (Continued). Patterns of all kinds, sizes and designs.

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General Aircraft, Briggs Mfg. Co., G. B. Bell Mfg. Co., Gear & Axle, Motors Motors, Gear Constructors, White Construction, Pulling, Petroleum, Ford, Navy Bureau, Naval Shipbuilding, and U. S. Engineering Corps. (Continued) are a few of the users of this remarkable time and money saver!

WAS PLAYS WITH THE MALLS INTERNATIONAL MYSTIQUE CORPORATION Established 1910

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(Continued from page 354)  
ing departments, is prepared with possibility and responsibility. These good standards for some third grade, standard shapes with adequate stress lines, more adequate bearings, methods for attachment for side and structure, etc., with adequate means of supply with reliable and data, designers will be largely free of detail design with much more time for new problems, which is the proper work of the group designers and their leaders.

Thus, the standard shapes will be with almost no preparation for interchangeability, which requires highly skilled men. For example, bearings, already far advanced in the direction of one standard interchangeable design, need 3 types of bearing gear compared with 27 in the United States. Early in the war, one contractor arranged with another to use the latter's more bearing gear assembly. This assembly was designed and used on a medium bomber and was adopted by the second contractor in order to supply different designs and purposes. This is considered normal in this country, but will be considered a blessing from heaven when the second airplane layout is made the same advanced supply have to obtain similar.

Project engineers must do much of this work; they must do much to maintain some engineers in the air rather than on the ground for both of them. When the days of peace come again, and the need to build for economy of manufacture and interchangeability, especially in the foreign countries where we export to most American airplanes, the work of today's standards engineers will be indispensable. Standardization belongs to us as a part of our condition of war or peace. With respect to new designs, the Standard Aircraft Standards Committee may become the heart of the Aircraft Engineering Society which we shall have but do not have now at least. The country should provide all of the American. Its such equality of action, a system may be made quickly of the best shop-working bearings for bearing gear, means to make some bearing gear which, control pistons and associated, day and day break mechanisms, gas slot elements, clamping bolts, and no maintenance system, and so on, so that in new requirements develop.

The requirement of the project engineers for the new standards should bring out every process and method of manufacture which has advanced beyond the current experimental stage. The minimum to there has been established, and to our opinion will not be lost in the manufacturing departments represented on the National Aircraft Standards Committee.



15 cents

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## Securing Means for Air Cargo\*

THE TRANSPORTATION of freight is today a reality. Forty percent of all U.S. shipments made by the Army is made in airplanes. I need not tell you that the major part of freight sent to our military was placed on Island and Alaska is moving by air. The transoceanic lines link to China, Russia,

By COL. F. S. EVANS

President, Evans Analytics Co.

ing supplies to Chongqing, is turning large quantities of it right there and the 4,500 trucks on the Burma Road—just what is being needed in England by the British Navy is the Army's secret.

In spite of the above facts, there has been up until now no scientific method of showing and sharing music in flight phases. This is not at all surprising because I can remember a year or two ago, when I was carrying on a series of experiments which led to the adoption of scientific methods for the location of

staple foods that sphenothale requires, would not even consider their feeding problems. They have too much on their minds and all of the difficulties of getting back to their great outdoors.

When the matter was raised, I was subjected to the harshest treatment on the floor, and those who rank behind me indicated also, none of which were based on accurate research, with the result that there were 38 derogatory articles of lasting notoriety, on file in 1942. This had true for a number of years after that time, through constant attacks and abuse directed at the automobile engineers committed to take no interest in the act after it was held to see that it carried with it the ultimate destruction.

It was in these early days that, relying on a series of intensive studies in experiments, I laid the foundation for the adoption of leading methods for automobile's which has since that time reduced roadbed damage almost 95 per cent while at 26 cents per automobile mile and which, in addition to about 200 million dollars saved the roadbeds, has saved the automobile companies and drivers another 200 million dollars.

The backlog of various construction licenses is supposed to be regulated by rules published by the Association of American Railroads and sponsored by a Lumber Rules Committee, but so an interim sum of three rules came out (none out until) to the market but change by the range and short on a change both of a useful hour.

That is the problem you can solve — you and all the thousands of other owners of Bushnell & Lomb 6 x 30 or 7 x 30 Binoculars. Your binoculars can help save American Wine and American jobs.

BAUSCH & LOMB  
OPTICAL CO. 100 N. 5TH ST. MILWAUKEE, WIS. 53233

[Turn to page 228]

<sup>2</sup> Paper presented at the Air Corps Engineering Meeting sponsored by the Education Office of the Ministry of Aeronautical Development with the cooperation of the Staff Air Staff, Ankara, the Air Transport Section of the Ministry and the Air Staff Liaison Office at Damascus, Dec. 5, 1944.

## WALKER-TURNER FLEXIBLE SHAFTING

**...meets war's  
hardest tests!**

in aircraft and other mechanical weapons—whose requirements are unusually severe—Walker-Turner Flexible Sheddling has thoroughly demonstrated a exceptionally high quality of design and materials. As one of the largest manufacturers of flexible sheddling for industry, Walker-Turner has gained wide experience in design, production and application of flexible sheddling for waste control and power transmission.

Although it is one of the busiest departments of this Company, we are always glad to help other concerns who may wish to learn more regarding the possibility of simplifying design through the use of flexible shelving. Walker-Towner Flexible Shelving is available today in products used for war purposes, in a wide range of sizes and specifications.

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They're in the  
Nitty Now

ON the bridges and look-out stations of American ships, brave men stand alert, searching the horizon—on guard against enemy attack. You can help these men, and thus help to hasten the day of Victory, by sending them your benedictions for the duration.

Binoculars are among the many optical instruments of war that Bausch & Lomb is producing and helping others to produce. Today, even with a twenty-four hour day, and vastly expanded production programs there is not room enough, nor time enough, to turn out all of the binoculars the Navy needs.

AN AMERICAN SCIENTIFIC INSTITUTION PROVIDING OPTICAL GLASS AND INSTRUMENTS FOR MILITARY AND EDUCATION, RESEARCH, INDUSTRY AND VISUAL CORRECTION.





**USE NORGREN LUBRICATORS**

Automatic... works only when tool works. Right feed... ends guesswork. Superior performance and speeds production. Sizes for every need.

severely and the phase should add. The whole range could be thrown at once and the centre of gravity changed to such a point that the plane would rock.

Angioma effluvia may be found, in excess of proper feeding, a condition. For instance, there are many types that are shipped in effluvia loads, where the best weights are much more than the value of the animal. Cattle and horses are often bled and impregnated with it. If proper feeding rules are not kept, the weight and space occupied in heavy cattle and horses can be replaced with material as very little, based on quantity and the period greatly increased. Proper linear methods, will accomplish this work and greatly increase the efficiency of what it means. It is kind of angiotensin, represented in this case, that it will take as a lower dose in angiotensin cases, and other parts, shipped as an final treatment.

[illegible]

The same general rule holds as true with air freight as they do with long rail freight and a study of the various loads now being made by sea route now will probably develop more facts that the total things shipped can be lowered at the expense of unnecessary damage.

If you know that each part of the corpse will be held firm, and remains in place and will have no chance to move or injure itself by becoming unbalanced, you can safely lighten the machine and make it more reliable.

Most of the present floors have been designed to be used in converted places built originally for some other purpose and, therefore, they are more or less sub-optimal as compared to what the final habitation or housing scheme will be.



**Four**

on The

### Good Reasons for Standardizing These Micro Switch Actuator Brackets

Designed to Carry the Air Corps Approved Type E-31 Mors Switch...  
For Complete Details of This Switch, Refer to Our Aircraft Catalog No. 27

These silver-backed eagles require no diversion panels as they are

They are all specifically designed to accommodate the Type B-31

They make Gold replacement a  
Type B-21 Aircraft (More, Swift)

The new Type M skeleton brush, 1000 series, weighs 10 lbs. complete with extended plunger and is made of anodized aluminum with a heavy-duty



Tease is a sound-  
current and alter-  
work for Type B.1  
Aircraft Maintenance  
Switch. Two three-  
bolts make replace-  
ment easy.



A-1 and A-2 Wings only. 15 less than Army reaches. The plunger on the beach nearly cancelled previous award—a total of 14'. The Aircraft Maintenance Beach is scored in the distance.

16" beyond the  
size as provided.  
Micro Switch is  
at shown in the

of switch open  
Type B 31 Series  
has two thru-bolts  
versions

The Type H comes out of which is a phone with a plastic sealed against a fixed with "A" strength or adjust.

If that's not enough, you'll find a good deal of basswood here, an uncommon tree in this area which can grow to 100 feet tall. The basswood is in flower, with its white flowers hanging in clusters. The

The mounting holes in the basket are an standard 10mm script No. 6-33 holes



The Y of your microscope basket

The Type T series must, unfortunately, search, roughly or steadily, for one day on the exhibition stand can be a

...has been a  
decade with  
They are open  
quadrant  
held  
opened by the  
release



Search operations: 16" on the Type I and 14" on the Type 8003. The Type 3 1/2 Micro Search is easily installed on two

Swedish operation takes place at 20% of plunger travel. Over-



Ordering No. 770

Data sheet No. 1  
full engineering  
the series M bear  
shown general data on

grind  
the oil  
73  
with the

Miss Smith is a sole owner business manufacturer in Miss Smith Corporation.

Collecting the 70 variables general data are available for almost all the 30,000 cases in the data set.

# MICRO SWITCH

Metalized in FREEPORT, Idaho, by Mono Smith Corporation

AVIATION December 1962

The following table shows the results of the regression analysis for the dependent variable "Number of children ever born":

Variable	Coefficient	t-statistic	p-value
Constant	0.85	1.2	0.23
Age at marriage	-0.02	-1.5	0.13
Education	-0.05	-1.2	0.23
Income	0.01	0.3	0.76
Urban residence	0.05	0.8	0.42
R-squared			0.05

244

AVIATION December 1987



Belden Wire is Used to Equip Many Bombers

## On Low Tension Aircraft Wire— BALANCED INSULATION Means Longer Service —under All Conditions

### BALANCED INSULATION

—on spark plug wire

Belden Code Resistance has been specially designed to meet the rigid requirements for high tension spark wire. Its properties have been carefully balanced to insure maximum performance in actual service. It has been tested and approved by the Bureau of Standards for conformance to Army Navy AN J-C-58 specifications. A wide range of other Belden high tension wires is available for all requirements.

★ Modern aircraft rigid requirements for power and lighting cable are more than met by Belden's new low tension wire with Balanced Insulation. Every characteristic essential to this service has been taken into account. Belden Primary Wire has been approved under AN J-C-45 specifications. It is

- |                                    |                                     |
|------------------------------------|-------------------------------------|
| 1. Heat resistant                  | 8. Moisture resistant               |
| 2. Cold resistant                  | 9. Well insulated for this service  |
| 3. Age resistant                   | 10. Impact resistant                |
| 4. Oil and grease resistant        | 11. Compression resistant           |
| 5. Abrasion resistant              | 12. Readily stripped—easily cleaned |
| 6. Flame resistant                 | 13. Low resistance                  |
| 7. Light in weight per unit length |                                     |
| 8. Small in over-all diameter      |                                     |

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Belden Manufacturing Company  
4605 W. Van Buren St., Chicago, Ill.

# Belden Aircraft WIRE

Starter, Lighting, and Instrument Cables <<< SPARK PLUG WIRES

## Designing Better Cargo Planes

A discussion of the deficiencies of converted passenger airplanes for cargo transport and future desirable operating requirements.\*

By CHARLES FROESCH

Chief Engineer Eastern Air Lines Inc.

ONLY TEN MONTHS have elapsed since the advent of the Lockheed 590s were called upon to begin the transportation of cargo on a large scale for the military services. The volume of cargo on the floor and on racks of duty aircraft have presented cargo handling and incorporating problems which must be satisfactorily solved before air cargo transportation can become a routine operation.

Expedient solutions are covering the present emergency but fundamental thinking and reworking must be followed to derive specifications applicable to cargo airplanes in order to establish the transportation of air cargo and so freight as a commercial business at the termination of the war.

Things has become an accepted means of transportation for the commercial traveler as well as the war freight but the coverage of needs by air has lagged seriously because of the lack of suitable frame equipment and handling facilities. Furthermore, the relatively small amount of space available for air cargo has been reduced the same for the routine high loads which, in most instances, have been higher per pound per cubic foot than passenger airplane rates.

When it became obvious at the beginning of this war that speed of transportation for aerial military support was essential, it was logical that available passenger equipment in use, or already designed and ready to be produced, should be quickly altered to meet this immediate demand.

The modification of this aircraft equipment was pressed into rapid operating service already designed and quickly converted for such service by the removal of all passenger accommodations, strengthening the floors with additional bracing and changing the radio equipment to meet military requirements.

This conversion was effective, although rather makeshift under the

circumstances of initial load in gross weight is increased, but this was partly offset by lifting increased weight restrictions and increasing takeoff weights to the order of 20 per cent with correspondingly safe and reliable

results, which incidentally, emphasize the conservatism of commercial equipment maximum operating weight ratings.

The standard Lockheed Lodestar, Douglas DC2 and DC3 transport airplanes were thus modified and are doing an excellent job. Later on, production of the C-47 which is basically a DC-3 cargo version having a large side loading door, the C-46, a modification

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**FOOLPROOF**—Set resin is not crusting, but good gripping qualities. Makes strong bond on green where perfect fit may be difficult or impossible to obtain.

**LONG ASSEMBLY**—Resists immediate peeling—or up to 150 days delay between application and pressure.

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\*Paper presented at the Air Cargo Transportation Meeting sponsored by the United States Bureau of the Bureau of Aeronautics, Engineering Division, at the Air Transport Association, 411 Lexington Ave., New York City, October 10, 1942.

of the original B-29 Superfortress. Curtiss Wright C-54B converted transport airplane, and the C-54, a conversion of the production B-24 airplane, scaled the ranks of cargo airplanes in expedient increments of military personnel and material. A more recent contribution was that of the Consolidated B-24 Superfortress bomber, in a stage of conversion and known as the C-124.

While the following discussion covers the utilization of all these airplanes as applied to air cargo operations, it must be remembered that most of these were designed strictly as cargo carriers in the conversion to air cargo

transportation load, therefore, most of these airplanes and conversions can be as subject to any stresses as the equipment manufacturers themselves.

In the first place, no one here just what a cargo airplane might be loaded with limited surface experience in cargo operations, such difference of opinion will prevail as the characteristics and operational conditions involved in the design of the type of airplane.

However, we are fortunate to be in the same position with business flight operators who previously thought how to take load parties in order to learn how to take mail runs.

**THE STEM DOES THE WORK IN A CHERRY BLIND RIVET**

Positive head formation and shank expansion produced by rivet stem. No bucking bar needed.

The Cherry Rivet is designed to do a first class riveting job in the blind or head-to-get-at places in aircraft structures. This rivet is actually an assembly, consisting of a standard aircraft rivet which has been drilled and through which comes an aluminum alloy mandrel or stem.

**SPECIAL GUNS USED**—The rivet can be placed in the work first or the projecting stem can be placed in the gun head and then inserted in the work. The gun may be either a hand-operated or power tool. (Head of the G-13 Pneumatic Gun is shown above.) In either case the gun pulls on the stem and pushes on the rivet head. As the stem is pulled through the rivet it forms a false head on the blind side, expands the shank of the rivet and permanently plugs the rivet. The pull contracts and like stem rivets and fixes the gun. The stem is then removed flush with flat ground surface.

**FAST OPERATION**—Cherry Rivets can be applied at the rate of 800 to 1600 per hour depending upon the type of rivet used. They give satisfactory performance with reasonable tolerance in gap length and hole size. Complete instruction on Cherry Rivets and their application furnished on request.

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**Cherry Rivet**  
Company  
LOS ANGELES, CALIFORNIA

Let us, therefore, further the utilization of these converted carriers and other expedient modifications for future expansion in the light of our limited operating experience.

First of all, we feel that the conventional type of loading gear renders loading of the various operations with large cargo planes, difficult because of the time involved. This is magnified by the lack of surface gear, too, being attached to help pull heavy items at the necessary rate as in the case. Also, that it tends to have a necessarily horizontal floor in the region of the loading door, the main floor makes an angle with it and causes concentrated loading when handling heavy large pieces of cargo with resultant floor damage.

Second, we feel that the standard passenger wheel lines are too weak to stand concentrated loads, as well as the weak design to which they are not subjected as cargo carriers. This has necessitated their reinforcement to allow strengthening the present floor structure in carrying it with an additional floor. This supplemental floor necessitates removal of plywood sheathing 2 in. to 2 in. thick and has been found quite unsatisfactory although it substantially increases the cargo weight.

Third, we feel that in the converted airplanes, the cargo entrance door is too narrow and too low to take the bulkier cargo pieces. This restriction seriously impedes efficient loading and unloading and limits the use of cargo pieces which can be handled. This is an important item when it is considered that the use of cargo pieces can, usually, cut down on weight to enable us to require winging in - airplane load around a critical of paying it, to note some main measures about 12 ft. in length, 15 ft. in width, 4 ft. in height and weighing 5000 lb. These and loads either have greater dimensions and/or weight. It would be desirable to have an additional door, located opposite, to enable simultaneous loading and unloading and this, once over on the ground, particularly when air is two points of a load too difficult to handle either due to size or weight.

Fourth, we feel that when we have placed the cargo within the airplane in the proper location, no means are available to enable the load to be moved or shifted in the cargo hold.

Each type of cargo presents a somewhat different problem in tie-down procedure. Methods of tie-down vary with individual surface irregularities due to lack of base provision in the airplane. Some operators have one tie-down device attached to the floor (Turn to page 361)

**SCOURGE of the PACIFIC**

Wake Island . . . Correll Sea . . . Midway . . . the Solomon Islands . . . wherever and whenever Topcats have the task, fast as transports . . . Grumman Wildcats and Avengers play an important part in winning battles.

The success of F4's and V4's is not a matter of chance. Sea duty and deck landings demand the strongest "guns" and pressure performance that Grumman builds into every plane . . . characteristics born of long experience in designing and building aircraft for specific services.

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### The GUARDITE CORPORATION

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(Continued from page 201)

frames, others have side rails and still others employ a combination of both means. The actual volume pressure is in the upper half in an unobstructed manner, usually delivering the force of the header behind the cargo. Sets are used but need frequent replacement.

Many ideas are being tried and each particular type has its own merits and drawbacks. No matter what the design means are carefully developed, these satisfactory applications will depend primarily on the proper loading of the loading personnel in their unit.

Fifth, we feel that no provision are readily available for a cargo header system.

Sixth, we feel a lack of simple and concise information to permit the loading personnel to accurately distribute the cargo load within the prescribed balance limits. In addition, it is often difficult to place heavy pieces within the column and still retain a center of gravity location which will not adversely affect longitudinal stability as well as lateral load bearing characteristics.

For instance, when a load of 6,000 lb is inserted in the C-46, the CG must be at a point, namely, 38 per cent of the column length, measured from the forward main wheel. This seriously limits the available placement volume of the cargo in bulk.

The arrangement of cargo is at best a process requiring intelligent action in view of the variable weight, size and type of cargo pieces, besides the fact that each cargo may be loaded for several destinations requiring placement in the proper position to allow emergency unloading.

Loading requires the coordinated effort of the plane crew, ground operators, loading personnel and, when in flight, communication to keep station orders due to loading and unloading at a minimum.

Seventh, we feel that the heavier equipment is in the wrong place as it is often difficult, in flight, to reach it from the pilot's cockpit with an airplane fully loaded with bulky material of low density.

Eighth, we feel that no provisions are available for the deterring and restraining in the passenger cabin occurred in steps comparable as found for cargo planes are the only requirements for passenger operation.

Ninth, we feel that each type of airplane has a different demand to ground height, maximum lifting or lowering the cargo when loading from a standard motor truck platform height. This has resulted in various delays, trip cancellations and inability to operate on schedule. For instance, the standard height from the ground is but 3 ft. 6 in. for

the C-47, whereas it is 6 ft. 8 in. for the C-54, or a difference of 3 ft. 2 in. between the two.

It has necessitated the use of make-shift devices such as loading ramps to enable transfer from standard truck platform height.

Tenth, we feel that the cross section of the fuselage, usually of circular or oval shape, does not permit continuous space utilization.

These are the primary deficiencies found in the operation of standard passenger transport airplanes for air cargo service as well as in airplanes originally designed for passenger operation and hereby suggested for cargo

aircraft.

While our primary purpose at the present time is to win the war, no matter, nevertheless, look ahead and make plans for the future, or at least try to consider what air transport operations are likely to be afterwards. Naturally, whatever changes are made by following this line of thought will also apply to military cargo replacement with the exception, perhaps, of speed, which for military purposes must remain more important than operating cost.

In thinking of the progress of air transportation and its place in our

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transportation, we must try to develop proper relationship with other available carrier means. Ultimately, we must hope to fly over heavily and carry every type of merchandise with maximum economy and speed, therefore, equipment, personnel and cargo by purpose and delivery of travel.

Before we can satisfactorily set down operating requirements for airplane demand loads for commercial air cargo operation, we must first determine just what are the fundamental laws which apply to the transportation of air cargo.

The prime job of the air cargo operator has to do with the shipment of the goods and safe transportation of his products. The most drastic law which is a sufficient law itself to attract and constrain to carry a large volume of traffic. An express volume has been built in the past primarily on the demand for emergency and perishable shipments which could bear a rate premium and in such case cost or profit is a substantial one.

On the other hand, emergency shipments, should be lowest possible operating cost per ton mile. This is a necessity

if we desire to obtain a large volume of business and compete with other means of express and freight transport which now have substantially lower rates per ton mile from door to door than we have been able to obtain with the airplane to date.

First-class rail express is moved at a cost to the shipper at an average of less than 10¢ per ton-mile and if the rate can be met, including packing and delivery cost, there should be a large volume of business available for movement by air and no doubt most commodities now being by rail express.

We certainly cannot hope, we expect to supply existing means of national transport at all our time or we will be in the course of making production, or fabrication of commodities or articles practically at all times are affected. The airplane will probably tend to use in the transportation of commodities representing either a high density or volume rate such as expensive tools and various articles that becoming commodities when at carrying finished products from factory to consumer with maximum expediency.

A low cost factor per ton-mile rate is not impossible if we substantially interpret and apply our present knowledge of aerodynamics, improvements in structures and large power plants to the design of sturdy cargo carrying airplanes.

It is true that salvage from past to present is immensely lower by air and that the elimination of heavy packing and destruction cost of cargo transportation and presents, efficient utilization of the airplane but still these advantages come far short of overcoming the detrimental factors of air and rail express costs.

We can possibly go further by employing the field of U.S. freight which could possibly be handled at normal, free or deferred expense, leaving a lower rate and used to improve the service load factor, thus reducing average ton miles to cost.

As a first step we must recognize the use of cargo gliders, known with tailwind and landing strips alongside airplanes, including general railroad sidings (wherever this function is limited to operating requirements of cargo airplanes only).

A cargo airplane should be a vehicle to carry merchandise not only at the lowest possible rate, but at the highest possible speed. High speed is essential but it must be obtained gradually, a reduction in average power loadings, operating costs will be higher over speed versus the mile cost is the leverage. This being the case

(Turn to page 31.)

**SLICES OF DAYLIGHT  
FOR NIGHT FLIERS**

They are here these flares that show where and where they went them... with International Flares and Signals. Whether to make landings more accurate or emergency landings more certain, they equipment parts the confusion of night and provide the illumination required. International Pyrotechnics are playing an important part in the military operations of the United Nations. Their quality and dependability meet every test.

Because of expanded facilities, we are now in position to serve commercial customers where previously service was not available.

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The Army Dept. is now awarded INTERNATIONAL for military use in preference.

**ARMY E NAVY**

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Have Good Reason for Pride in Both..."*

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WITH these inspiring words the great Army and Navy 'E' pennant was awarded to the men and women of the Switlich Parachute Company—for high achievement in the production of war equipment.

The Switlich Parachute Company is deeply honored by this citation from the fighting forces of the nation, and equally proud of its own soldiers of production who have labored unceasingly and effectively in the service of their country.

Prior to Paul Hulse, Switlich was America's largest manufacturer of parachutes. Today, in serving the air forces of the Army and Navy, the hundreds of Air Corps training detachments and many civilian pilot training programs in this country of democracy, the Switlich Parachute Company continues to maintain its leadership in this field by its vast contribution to our nation's war efforts.

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## BUILT-IN TAIL WIND

SHOWN ABOVE is an amazingly effective device for increasing the speed, cruising range and climbing ability of airplanes.

It is a molecule—represented by a chemical model 100 million times its size—of neo-hexane, one of the modern synthetic products of the petroleum industry that far surpass gasoline as fuel for aviation engines.

The discovery of neo-hexane (known also as 3,3-dimethylbutane) was a triumph of the petroleum industry's persistent search for more efficient fuels. Long before Pearl Harbor, the American oil industry had discovered and developed processes for standardizing this and a number of other high octane blending agents so that today we are able to supply all phases of the United Nations with very high octane motor fuel.

The production of aviation gasoline is no longer a matter of simply distilling and cracking crude

petroleum. It is a highly complex chemical art—a science of synthesizing special compounds that can be blended into fuels of predetermined characteristics.

Among the chemicals which give our aviation gasoline its high antiknock quality is Ethyl fluid. That is why Ethyl engineers cooperate with the petroleum industry in their search for better aviation fuels. And, since both fuels and engines are so closely related in their development and use, we also do all that we can to be helpful in the development of engines which will best utilize these improved fuels.

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Chrysler Building, New York City



Manufacturers of Ethyl fluid, used by all refiners to improve the antiknock quality of aviation gasoline.

(Continued from page 308)  
tail, would have to be sized and volume obtainable lowered.

For a given airplane, designed for a specific gross weight, and having a given wing loading, there is a power loading which is most economical. In other words, there is a balance between maximum payload and lowest cruising horsepower on one hand, and low power loading with reduced payload on the other.

This can be readily determined with a given airplane by calculating its transportation efficiency factor expressed in  $\text{hp}/\text{sq. ft. wing}/\text{hr.}$  for several horsepower values. That is:

$$P \div W \times T$$

Where  $P$ —payload is in tons

$T$ —time in hours

$W$ —wing area in sq. ft.

The overall efficiency factor of the airplane can be obtained by multiplying the structural efficiency expressed by operational weight load gross weight by the transportation as expressed by cruising speed/ton, and plotting against range.

Obviously, there is nothing to be gained if due to high speed the cruise must wait several hours to be unloaded at destination, such as might occur with a load of perishables being left in the field of action the evening before and arrived at destination several hours ahead of necessary delivery time.

I like to touch on the question of airplane size, except to mention that it must be remembered that larger airplanes permit higher ratios of useful load to gross weight and also greater reserve for a given load, in many airplane components and detail weights do not increase proportionally to the gross weight. Airplane size at present is limited by available engines, although this existing restriction may be removed with the emergence of larger engines requiring several years to design and fabricate experimental prototypes. As a matter of fact, engines will need to be increased and developed to permit lower fuel cost per ton mile and more miles per gallon as also air cargo capacities may find themselves seriously restricted especially for long range operations.

Large airplane size and capacity cannot be predicted until a thorough analysis of the air cargo and freight market has been made. All we know is that big engines is here to stay and that the volume will depend on the cost of the service to the shipper. Also, that no doubt will follow as the scale of air, water, and land transport will be made to include air transportation competitive with other means.

Obviously, the value price of any



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Oster appliances) that includes years of service for various departments of United States and foreign governments. . . . All these are facts that back up your good judgment in selecting Oster. Remember Oster as a name worth remembering, in the fractional H. P. field. *John Oster Mfg. Co., of Ill., Genoa, Ill.*



(Continued from page 372)

ers, which have been carried in the air, to emergency shipments.

From the recurrent point of view it does not appear logical to increase the engine weight of every cargo airplane of a fleet to handle the 18 per cent of cargo and the volume may be that only a few such cargo airplanes will be sufficiently strengthened to take what is virtually heavy freight.

Cargo space volume for any given airplane size should be based on an average engine or freight density.

Mail freight averages 30 lb. per cu. ft. and mail express about 12 lb. per cu. ft., while stored explosives 3 lb. per cu. ft. If we assume that explosives in packaging can reduce engine loss 50 per cent, we arrive at an average density of approximately 55 lb. per cu. ft.

Allowing for reasonable space plus a certain amount of space to the rear of the loading door which should probably be kept clear at all times, we come down a density volume ratio of 8 to 9 lb. per cu. ft. as design criterion in determining the size of the cargo compartment.

Cargo stowage must be light and efficient, suitable cargo tie-down devices should be provided fast-mounted and built integrally with the floor and side wall structure. Fasteners should be made for a flexible separation of the cargo compartment space into bins and sections, such as may be obtained by the use of movable partitions with flexible partitions such as chain drapes, which are built. The side walls up to a maximum height of 12 in. from the floor should be protected by means of suitable removable panels, slatted panels from mounted plates having rubber shock absorbers from the ground to their maximum height to some load weight for maximum protection.

Only sufficient windows should be incorporated to give satisfactory light and these must be partitioned. Cargo compartments lighting must be protected against damage. Such lighting should be adequate as much work will be done at night.

#### Heating and Ventilation

The entire cargo compartment should be well insulated without being airtight. Heating should be provided in the design to maintain a 50 deg. F. temperature which is necessary when perishables such as bananas, grapes and such are to be transported.

It will be necessary when operating in cold climates to provide temperature maintenance and such maintenance should be made readily removable for fire reasons. First, weight saving when

it is not needed and second, to allow possible cleaning.

It is not believed that the cargo compartment, as a whole, needs to be completely, although such maintenance should be made available in sections in case it should be required. Provision should be made for air conditioning and possibly refrigerating.

#### Codging

Codging arrangements should include space for cargo handling station. The

range handler's duties would be to keep track of all cargo going, check destination of cargo, supervise loading and unloading, check the CO location of the cargo for balance, as well as any other "in flight" duties which may be required.

A small engine compartment should be provided and readily removable from the cockpit for the refueling of the sides. These compartments should be close to the cargo handler's station in



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THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia  
The World's Largest Manufacturer of Storage Batteries for Every Purpose  
Exide Batteries of Canada, Limited, Toronto

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AIRCRAFT  
BATTERIES

IN THE AIR SINCE 1917

AVIATION December 1942

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### ... and Save Vital Materials, Time and Money ...

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Stainless steels are used throughout industry because of their superior resistance to corrosion and oxidation and their remarkable strength-weight ratio. Typical applications in essential industries are shown at the right.



We have more than 25 years' experience in the production, fabrication, and use of stainless steels. Although we do not make steel, we produce the "Electromet" brand alloy and metal used in making steels. Therefore, we are in a position to give impartial advice on selecting the steel best suited for your needs. If you have a problem involving the physical or metallurgical properties of stainless steel, call upon us. There is no obligation.

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Stainless pipe demonstrates from 14 per cent decrease steel sheet area used in reinforcing towers.



Aircraft engine exhaust pipe of 18-8 alloy steel reinforced with columbium contains 1 to 2 per cent molybdenum.



Heat exchanger of 18-8 molybdenum alloy steel resists both organic and inorganic acids and alkalis.



Stainless steel (18-8) drum and frame of the vacuum filter belt heat press with clean and pure.



Stainless steel of 18-8 molybdenum alloy is used in the manufacture of top boiler tubes.



Insulator used for increasing the wire (Vibron) 3 content of alloy is made of 18-8 stainless steel.



Stainless steel under of 18 per cent chromium steel resists corrosive chemical action.



**TAPES FOR AVIATION USE**

What tapes do you need? Airwing offers you a complete selection . . . ginked edge, scotched and biased tapes . . . Grade A, light-weight and balloons . . . Utility, reinforcing and hermetic tapes. Airwing airplanes and glider fabrics round out the famous Airwing line.

**W. HARRIS THURSTON**  
 40 Worth Street, New York City  
 Factory and Warehouse—17 Bouch Street, N. Y.

WESTERN REPRESENTATIVE—MELTON F. CHAPEL, 8604 SAN FERNANDO ROAD, GLENDALE, CALIF.

AVIATION, December 1940

## BAKER TRUCKS can help you to *Speed your deliveries*



### 1. FASTER LOADING AND UNLOADING

Many men hours are used loading and unloading box cars, trucks and trailers with Baker Low Lift and Elevating Trucks. Baker Crane Trucks speed loading and unloading of heavy, bulky materials on flat cars or ships.

### 2. SPEEDING PLANT PRODUCTION

By keeping materials moving and stepping up efficiency of machines and men, plant production can be increased and delivery dates moved up.

### 3. SHIPPING AND RECEIVING IN UNIT PACKAGES

The use of skids and pallets with Baker Trucks eliminates individual handling of parts or products—saving time on both shipping and receiving ends.

### 4. LESS DAMAGE IN HANDLING AND TRANSIT

By reducing jostle handling and by better placing of materials in cars or trucks, loss by damage to merchandise is greatly reduced.

### 5. BETTER WAREHOUSE HANDLING

Baker Trucks speed handling in storage and bring the warehouse many minutes nearer to the loading platform.

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### THE BAKER MATERIAL HANDLING ENGINEER CAN HELP YOU

He knows how to make your material handling more efficient to speed your deliveries. He is at your service.



**BAKER INDUSTRIAL TRUCK DIVISION**  
*of The Baker Railway Company*  
 2161 West 25th Street • Cleveland, Ohio

2000-5-43

# Baker INDUSTRIAL TRUCKS

In Canada: Railway and Power Engineering Corporation, Ltd.

AVIATION, December 1940



**Better Lighting could  
have saved this hand!**

11,400 industrial workers are killed or injured every day! Many of these tragic accidents happen simply because workers cannot see clearly and safely in all times. Read how MILLER lighting can help you save lives, protect skilled labor, and speed war production in your plant....

Last year industry lost 42 million man-days through injuries alone! Think of the staggering cost to the war effort.

Better lighting is one positive way to reduce industrial accident hazards.

In one war plant, for example, accidents decreased 11% after a new lighting system was installed. To assist the frequency of minor accidents dropped nearly 50% when illumination was increased 25 foot candles.

These figures are from WPA's useful handbook, "Plant Efficiency."

MILLER 50 FOOT CANDLER or 100 FOOT CANDLER can put an adequate, day-saving level of fluorescent daylight over every working surface in your plant. Watch what that does for winter months and year-round safety progress!

Or it may be some other type of MILLER lighting.... incandescent or mercury vapor, for instance.... is more ideally suited to your individual needs. MILLER works with all light sources and is in an excellent position to give you the one best lighting system for your plant and supplies.

MILLER engineers are located in principal cities. Ask to have one call for a serious discussion of how better lighting can help you now.

**BUT U.S. WAR BONDS**

**THE  
MILLER COMPANY**  
MILWAUKEE - CHICAGO

*Planners in Good Lighting start this*

## On the first flight to Victory...

A Tokyo knows General Streamline flies... and so do the masses that are helping to create the greatest air armada the world has ever seen. Unimproved and muddy fields... constant inexperienced take-offs and landings... call for tires that have the built-in strength and quality that spell safety.

So the call went to General for an even rugged tire equal to this vital, strenuous service.

Backed by one of the longest records of practical experience in building aviation tires, Generals are demonstrating that they have what it takes... whether on a C.A.P. ship, minor or heavy bomber. For your safety, too... depend on General.

See your *Fixed Base Operator* or Write,  
**THE GENERAL TIRE & RUBBER CO.**  
Aviation Division, Akron, Ohio

**THE  
GENERAL  
AIRPLANE TIRE**

Drawing above is from actual photograph of 3 Boeing bombers destined for Peru, Generalissimo, China, U. S. Army and U. S. Army Corp in bonded.

— KNOWN AROUND THE WORLD FOR QUALITY AND SAFETY



## SALUTE TO SKY SLUGGERS

Sinclair salutes Bell Aircraft Corporation, honored by an Army-Navy "E" for excellence in production.

Excellence in performance merits another salute — this one to Bell Airacobras slugging their way with cannon-fire, speed, and maneuverability to mastery of the air.

For safe lubrication of engines in strenuous flight tests before Airacobras are passed for military service, Bell uses Sinclair Pennsylvania Motor Oil.



FOR FURTHER INFORMATION ABOUT SINCLAIR PENNSYLVANIA AND OTHER SINCLAIR AVIATION LUBRICANTS WRITE:

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PITTSBURGH

AVIATION, December, 1942



## One decision you can make today ...about tomorrow

Take a look at what we're doing today, rushing out aircraft armament; Automatic Bomb-release Buckets, Cannon parts, Bomb-release Shockles and hardware for all types of military planes... all to exacting specifications... on a 24-hour, 7-day production basis... and delivering on time with the lowest percent of rejection! (And mind you, we were doing this long before Pearl Harbor.)

Now take a look at tomorrow... when the democratic peace comes and the competitive struggle for private business begins. When the buyer is going to demand better products at still lower prices, or else. Tough guess, isn't it?

The decision you can make today, about tomorrow, is to plan on using the Spriesch modern

war production ability to insure your survival and leadership in the battle for business.

We shall be glad to work with you. Our business is metal fabrication, special or production work, tools, dies or parts to your order.

Please write with us for tomorrow.

Joseph J. Cheney, President.

Write Us: "Send Brochure"

As it is pictured we complete facilities. Please use your business letterhead.



**★ WE OFFER ★**  
**INGENUITY**  
and extensive facilities to give your business an edge through production—complete services or parts with maximum economy, minimum cost, reasonable cost.

# Spriesch

Established 1913

TOOL & MANUFACTURING CO., Inc.

10 Howard Street

Buffalo, New York

AVIATION, December, 1942

315



Safe landings through  
the eyes of science

That's the last hazard  
Of a boating mid-  
After the dark  
And the stormy nights  
Piercing your ship safely down  
On the bottom field

Imagine a pilot in the last war  
With the weather against him  
He knows his fate  
Is somewhere below  
Should he discover and fog  
The main circle and circle his plane  
In dark dispersion  
Hoping the crash won't be too bad.

Now Uncle Sam's pilot  
Can head home  
And set their steps down  
In weather as black as a witch's hat

Modern radio equipment  
For instrument landings  
Is designed, developed  
And manufactured  
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The broad precision experience  
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In the field of communications  
Is proving its value  
In time of war.

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Manufacturing Division FEDERAL TELEPHONE AND RADIO CORPORATION  
formerly operating under the name International Telephone & Radio  
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AVIATION, December, 1942



# SCHATZ

*Precision*

## AIRCRAFT

### BALL BEARINGS

SCHATZ CONTROL BEARINGS  
MEET THE MOST EXACTING  
ENGINEERING SPECIFICATIONS •

PROVIDE  
SAFE, DEPENDABLE CONTROL •  
STRONG • TOUGH • ACCURATE  
BALL BEARING EFFICIENCY PLUS THE  
SCHATZ REPUTATION FOR PRECISION  
MANUFACTURE KNOWN AND RECOGN-  
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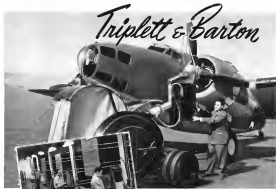


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AVIATION, December, 1942

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ABOVE—NEW PORTABLE X-RAY TRAILER, DWT X-RAYING  
POSTER OF LOOSE-ROD HYDROM. INSET—ARTIST OF  
X-RAY MACHINES AT A TRIPLET & BARTON LABORATORY

## An ounce of prevention

In field or factory, an ounce of prevention is and always will be worth a pound of cure. Triplet & Barton's latest verification of that old adage is the portable X-Ray trailer unit—a laboratory-on-wheels. Completely equipped with dark-room and refrigeration for constant temperature, this 200KV unit has hydraulically operated viewing ports and has full range between heights of eighteen inches and eight feet

The mobility of the trailer X-Ray makes it extremely versatile—for parts too large for the laboratory—for assembled units, in tanks or ships or airplanes, where countless hours of disassembling and re-assembly can be saved. Triplet & Barton is proud to offer another "first" in the field of aerial X-Ray—another aid available to any war production plant for cutting loss of time. Present your aerial problems to Triplet & Barton, X-Ray pioneers

**TRIPLET and BARTON, Inc.**

WICHITA, KANSAS • BURBANK, CALIFORNIA • SEATTLE, WASHINGTON

AVIATION December 1942



**On the job . . .**  
*at every take-off*



From the list of Simmonds registered aviation accessories, the following are in routine production for the fighting forces.

**Simmonds-Corsey**  
**FLEXIBLE PUSH-PULL CONTROLS**  
**CARDANOMETRIC RADIOSEES**

**Simmonds-Bentley**  
**SPARK PLUGS**

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**HYDRAULIC ACCUMULATORS**

**Simmonds-Mohr**  
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**Simmonds-Pratt**  
**REB ENDS**

**Simmonds type**  
**SCWING AND PANEL FASTENERS**  
**IN CLIPS AND RINGS**  
**QUICK DISCONNECT UNITS**

AN ever growing number of America's hard-hitting fighting planes are equipped for efficient performance with Simmonds products. One or more items from the list of Simmonds aviation accessories is in action on world-wide fighting forces with every American bomber in the air today.

Simmonds is proud that all its manufacturing experience and facilities are enlisted in the battle for Freedom. It takes pride, too, in the increased demands for the high quality, performance-proved products which it manufactures in quantity. Until Victory is ours, Simmonds precision-made parts will be "on the job at every take-off".

**SIMMONDS**  
**REORGANIZED INC.**

10 ROCKEFELLER PLAZA, NEW YORK, N.Y.

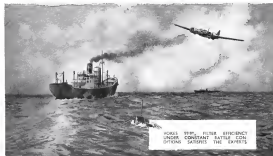
Metropolitan Building, Dayton, Ohio • 4233 Hollywood Blvd., Hollywood, Calif.

AVIATION December 1942

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## FILTRATION A 3 SERVICES PROBLEM

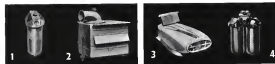


VOKES' 300 P.S.I. FILTER EFFICIENCY UNDER CONSTANT BATTLE COAL OILS SATISFIES THE EXPERTS



WE have a lot of "talk" about men going overseas, because it concerns the people. But the engineers experts of the services have their own special problems, engine power, aero-engines in their thousands, the mighty engines for submarines, auxiliary motor craft and mechanized units of the Army, each and every one has to be kept "fighting fit." That is why the filtration of sea, oil and fuel oil in these engines is of such vital importance, because in points of size, oil and fuel oil for engines depend power and speed. Our organization is working so eagerly to provide Vokes Air, Oil and Fuel Oil Filters to all branches of the services. R.M. and Dominion Governments approve and adopt Vokes Filters. Their 98.9 per cent. standard of filtration efficiency is unsurpassed, and has been tried and tested out under actual fighting conditions. Like everything connected with the fighting forces, Vokes Filters don't half do the job, but do it thoroughly.

1. Vokes High Pressure Oil 2. Vokes Tank Oil Bath Air 3. Vokes Air Filter for Aero-Engines 4. Vokes Turbine Oil Filters for Diesel Engines



# VOKES

VOKES LIMITED - FILTRATION EXPERTS

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8. GANTON 301 BARK AVE. WEST BOMB

AVIATION December 1942

# SEGREGATED Scrap...

is your link to VICTORY!

Scrap salvage is a vital factor in the war effort. To be fully effective a scrap program must include methods for segregating and conserving critical alloying elements as urgently needed in the construction of tanks, guns, ships and planes.

Ferrous and non-ferrous metal scrap should be collected in separate containers at the machine where they are generated. Each class of high-speed

tool steel and each type of constructional alloy steel should likewise be kept separate so that the alloy content can be returned to service.

Remember, — alloy scrap which is segregated, classified and labeled according to type and composition is a vitally important commodity today—and urgently needed to augment primary supplies of Nickel, molybdenum, tungsten, etc.

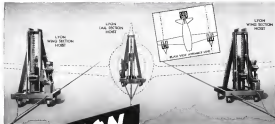
The metallurgical experience of our technical staff is available to aid you in these and other phases of metal salvage.

**KEEP SCRAP MOVING INTO WAR PRODUCTION!**

**THE INTERNATIONAL NICKEL COMPANY, INC.** 87 WALL STREET  
NEW YORK, N. Y.

AVIATION December 1942

291



THERE'S A **LYON**  
AVIATION UNIT  
to fit every purpose in—

- ★ PRODUCTION
- ★ MAINTENANCE
- ★ OPERATIONS
- ★ GROUND CREW

## ... MATERIAL HANDLING!



For each of the above units, see the LYON catalog, which contains complete details of the full service.

Whatever your requirements may be—LYON MATERIAL HANDLING EQUIPMENT will solve your problems better—faster—more efficiently! The superiority of Lyon Hydraulic operation in lifting power, reliability, and easy, economical action is proved in hundreds of installations already on active duty throughout the aircraft industry.

Numerous sets of LYON Portable Hydraulic Hoists, pictured above, were built for a large airplane manufacturer to change the height of plants in the final assembly line. They are used also in bays for lifting plants to convenient servicing positions. We are also prepared to build units such as Airplane Spotting Dollies, Supercharger Positioning Tables, and Cargo Loading Trailers, to meet particular requirements.

Our engineers, backed by long experience with every type of material handling problem, are well qualified to cooperate with you. If there is a particular stumbling block in your material handling procedure, let Lyon Engineers analyze it, and submit recommendations without obligation.

Send for our outstanding booklet—"The Answer to Production and Servicing Problems in the Aviation Industry"—it's free, and it will show you the way to simplified material handling. The Lyon Way!

LYON PORTABLE HYDRAULIC HOIST—An advanced and efficient machine of the hydraulic line.



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- ★ We are equipped for test transmission measurements ... structural measurements ... ground transmission measurements ... and efficiency and vibration tests on all types of instruments and mechanical appliances.

When making inquiries, please indicate the specific problems with which you are faced. This will enable us to give you the pertinent information you require concerning our services, without delay.



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ESTABLISHED 1940

PHILADELPHIA CHICAGO WOODBRIDGE GREENSBORO NEW YORK

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## ... But Deadly Accurate!

Every bomb that drops true to the target at Tokio represents a collaboration by thousands of Americans—engineers and workmen as well as air force personnel—Dole engineers, skilled men and women included.

Not all the accuracy is obtained by science or mathematics—not by a bomb sight! Hydraulic control lines to bomb keys, wing flaps, landing gear—flight controls in use and not under repair—no long flights—these need their Dole Valves and Fittings play their part in getting the plane into spot-on bombing position.

The machined and unexpected accuracy of the Dole elbows, tees, cocks and nuts contributes to the total accuracy of the plane—contributes importantly when you consider their uniformity as produced in millions.

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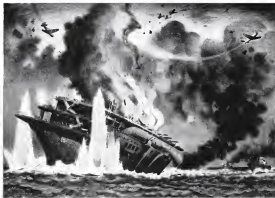


To Air Corps, Navy and  
AN Specifications



# DOLE Aircraft Valves & Fittings

AVIATION, December, 1942



## AMERICAN BOMBERS SINK JAP CARRIERS!

Pictured here is a Japanese seaplane carrier, with its characteristic horizontal funnel, after a direct hit by an American bomber.

"More planes plus more carriers" is America's answer to the Axis powers. As the accumulated force of America's equipment and training become felt—we shall begin "to hit the enemy and hit him again."

As one of the largest producers and distributors of coping fabrics for all our war

effort, Wellington Sears Company has turned over the full facilities of its 18 mills to Army, Navy and Air Force needs.

B\*A\*30 AIRPLANE CLOTH and WARWICK BALLOON CLOTH both play an important part in the equipment and protection of our armed forces. Therefore, these fabrics are now available only on a priority basis and in accordance with the provisions of General Preference Order M-197.

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*Cottons* **OFFENSE** FOR **DEFENSE**...WELLINGTON SEARS FOR *Cottons*

AVIATION, December, 1942

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Count on . . . .



. . . and year after year aircraft manufacturers count on FLIGHTEX for fabric that's lighter, stronger, smoother — that surpasses U. S. Army and Navy specifications.

Each year more manufacturers buy more FLIGHTEX than any other airplane fabric.



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A Counting  
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Standard range of temperatures runs from —40° to 150° Fahrenheit. (Special units test from —95° to 335° Fahrenheit.)

Observation ports permitting full visibility are used to prevent interior condensation. The interior is scientifically air-conditioned.

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The American people and their government are fully, fiercely aroused today. They are fighting this toughest of all wars with every nerve and sense . . . ready to wreak destruction on the enemy.

The Army Air Transport Command, The Naval Air Transport Service, and The United States Maritime Commission have organized

and are directing the most gigantic transportation job in world history. Due to their combined efforts, the greatest fleets of aircraft and ocean-going vessels ever assembled are now operating to all corners of the globe — on a scale that defies imagination.

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## 365 "Heart-Beats" a second!

- In today's giant aircraft motors a pair of contact points meets, passes an electrical charge and "breaks" apart again . . . three hundred and sixty-five times every second. That's twenty-one thousand nine hundred times every minute!
- This is the "normal pulse" required to maintain maximum efficiency of the huge throbbing engines of Uncle Sam's war birds.
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[illegible]

In this single plant in the avian seed industry, many key elements may be found. All are different—not readily transferable by application of cold carbon dioxide—Carnegie-Norcross applications are apt to be identical in use, local conditions, relation to the rest of the plant, or actual fire damage. That's why the standard measures of C.

Cardus and solitaires pupae live in temperatures 40° or needed, to any one of many insects. From a central supply is large as 100 tons or more. Antennae complex, thorax and wing in a constant, are used in a continuous manner.

In supplying an instant in place protection for today's critical needs, Cardex engineers offer a full scope of vital experience. Their performance in aviation industries is of special value. Contact them for an estimate of what Cardex can do for your plant.

Write for Bulletin No. 3122.

# CARDOX

### NON-DAMAGING FIRE EXTINGUISHING SYSTEM

CARDOX CORPORATION • BELL BUILDING • CHICAGO

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AVIATION December 1960

**BRAND NEW BOOK**  
by an international authority!  
An absolutely unique aviation dictionary!

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Over 2000 aviation terms doubly defined—by clear, concise text and by technically correct, scientifically exact drawings that explain precise meanings at a glance!

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[illegible]

## WHO IS JORDANOFF?



Zerothick is a name in conjure with in aridness-M  
tates of sculpture experience. In the world War I  
the most famous aircraft engineer, and he is the  
signature of the most successful engineer on aviation  
aircraft. From White, Through the Orange, Flying  
and How to Do It, History in Flight and the World War  
The Most Famous the Flight Both the British and  
United States have used several hundred thousand  
pounds each. A total of over 100,000 copies have been  
country was not so considerably great. It is a book  
of the world, the other part together. It's a book  
of the world, the other part together. It's a book

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AVIATION, December, 1980



## It took FIFTEEN YEARS to build our World Routes, now so vital to Victory

*Every American knows the story of Leona and Clark—the men who pioneered a trail across the North American continent to the Pacific.*

But few Americans know the story of how Pan American Airways—our Merchant Marine of the Air—pioneered a similar route across oceans and down the length of South America in the short space of fifteen years.

In Central and South America, challenging treacherous, headwind-mile currents and deadly jungles blocked the path. For much of the territory no accurate maps existed. None had been made since the 17th century charts of the Spanish, Dutch and French explorers.

To open some of our early airports on the route to the Panama Canal, ground had to be carved, so by hand—long lines of natives, each with a five-gallon tin balanced on his head.

In the Pacific, at Midway and Wake Islands, there were no harbors. Construction teams

had to be towed through heavy seas, floated over hammer reefs and landed on the beach despite the heavy banders.

Across Mexico also, airports had to be hacked out of jungles and built up on desert wastes. At some points the only available landing power was furnished by candles. Native Americans who had never seen an airplane were employed as artisans.

In Alaska, summer is brief—roads did not exist. Airports had to be built on volcanically swampy moraines or, when it was available, on glacial gravel and sand.

Today all these routes are playing their part in hastening Victory for the United Nations.

Without exaggeration, it can be said that the existence of facilities pioneered by Pan American has one of the United Nations' aerial war transport many long months.

## "Great Accomplishment in the Production of War Equipment"



Upon the men and women making up the organization known as A. SCHRAIDER'S SON, Division of Scovill Manufacturing Company, Incorporated, has been conferred the Army-Navy "E" Award for "Great Accomplishment in the Production of War Equipment."

We take this opportunity to thank the men of the Army and Navy, our employers and our suppliers, whose efficient cooperation has contributed so much to make possible the honor we proudly enjoy.

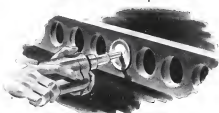
# Schrader

A. SCHRAIDER'S SON, Division of Scovill Manufacturing Company, Incorporated, BROOKLYN, N. Y.

## Wings over the WORLD PAN AMERICAN CLIPPERS

# 

Grinds top and bottom edges of holes  
to true radius — all in one operation



**T**HE job of removing the burr and producing the true radius required on all holes in aircraft engines has been greatly simplified by the introduction of the slotted abrasive disc. Made of Alundum Braided Electrocoat Abrasive Oxide Metal Cloth, these discs are being widely used for burring and polishing all metal hole edges, from  $\frac{1}{8}$ " to  $\frac{1}{2}$ " in diameter.

The speedy performance of the disc is a result of the flexibility achieved by its slotted design. Using a disc proportionally larger than the diameter of the hole, mounted on a spindle for use in a portable electric or air-driven tool, the operator presses it against the edge of the hole, as in the diagram below. Accommodating itself as the opening, the disc "coats" backward, rounding only the edge of the hole, leaving the flat surface unaffected.

If both ends of the holes are to be finished, two discs mounted back to back are used. They are first pushed through and then pulled back against the opposite edge of the hole.

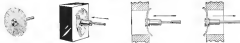
Units for this new slotted "Weapon for Production" are easy and varied. Such parts as valve rocker arms, connecting-rods, upper guides, oil holes etc., having openings larger than  $\frac{1}{8}$ ", are typical of its wide applications.

In ordering slotted abrasive discs, it is important to select the correct grit for the kind of metal employed and the finish required.

If you care to try a few of these slotted discs we will be glad to send them free of charge. Simply address your request to Dept. A. The Carborundum Company, Niagara Falls, N. Y.

**CARBORUNDUM**  
A Division of

### 



**THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.**

Sales Offices and Warehouses at: New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids, Milwaukee and Akron are regional distributors of and within territories of The Carborundum Company.

AVIATION, December, 1942

# 

## 

... the Manufacturers we represent, and to all others in the Aviation Industry, for their cooperation and confidence in us.



... our Continental clients abroad, who for years have entrusted us with the procurement of their particular needs.

... our American and Allied clients, who are currently working themselves out of diversified procurement experience.



... the Aviation clients abroad, our vast group of international reciprocity.

... the Banks, whose world-wide facilities have assisted us in the complex problem of foreign finance.

... the great Technical Institutions of America, for providing us with competent personnel.



... the members of our organization, excepted or visiting from countries now overrun by our enemies.

... the Aviation men in the Armed Forces, whom we will welcome back when Victory is won.

... our employees on the Home Front, for their untiring efforts and loyalty.

... our energetic representatives, and our friends throughout the world, for their unending cooperation these many years.

# 

LINKING AMERICAN MANUFACTURERS WITH FOREIGN AND DOMESTIC MARKETS

**AVIATION EQUIPMENT & EXPORT, INC. 25 Beaver Street, New York, N. Y., Cable AVIQUIPO**

AVIATION December 1942



Give the Lame Ducks a Chance to Fly Home



If an aircraft electric motor burns out, the plane is likely to be gone goose and its crew lost. At the least, the plane is out of service until a spare motor can be obtained and installed.

But if you are aircraft electric motor that has built-in Klaxon Protection, you get an entirely different story. Those motors can't burn out. If a jam occurs and a motor is overloaded to the danger point, the built-in Klaxon Protection auto-

matically cuts the motor off the line. The motor cools to a safe operating temperature, then runs again, automatically. It keeps working on an "on" and "off" basis—"lame duck" fashion—until the jam is eliminated and overload conditions are corrected.

Any type of low voltage D.C. motor—up through 30 volts—can be supplied with built-in Klaxon Protection. Inquire on this protection. Ask your supplier today.

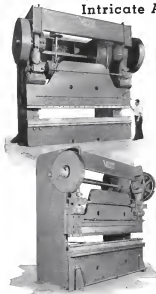


**KLIXON**  
Klaxon Protection

SPENCER THERMOSTAT COMPANY • ATTLEBORO, MASSACHUSETTS

AVIATION, December 1942

## use **Verson** Press Brakes for Forming and Multiple Punching Intricate Aircraft Shapes



**V**ERSION Press Brakes are designed for jobs demanding the most in precision and production performance. Accurate bends and maximum punch and die life are assured through their balanced distribution of steel plate. They are built by the originators of all steel welded construction in the manufacture of punch presses—built to include many features that allow faster, better and more economical production.

Verson Press Brakes, ranging in capacity from 8' x 1/4" up to 14' x 1/2", are available to the aircraft industries on seasonably quick deliveries.

Send for your copy of the new aircraft edition of the Verson Die Manual.

## **VERSON ALLSTEEL PRESS CO.**

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Chicago, Illinois

**POWER PRESSES • HYDRAULIC PRESSES • CLUTCHES  
FORGING PRESSES • PRESS BRAKES • DIE CUSHIONS**

AVIATION, December, 1942

417



## How Sally used up a copper mine

**L**OOK at the picture carefully. See that efficient under Sally's arm?

It is significant. In fact, it's a humble version of our production.

Understand the efficiency of that arm—and you understand one of the basic reasons why, in less than seven months after war-conversion, American industry is producing for Washington to provide more copper and other basic raw materials.

► Before Sally got her arm-rest, she crashed over to a box, picked up a very part for an airplane instrument and filed it in the machine. . . . Now the supply box is filled and constantly jiggled, so that the parts flow to her fingertips. With each motion Sally saves a fraction of an ounce of energy and half a second of time.

Without tiring, working without effort, America's 20,000,000 factory workers would be hopelessly handicapped in their race against the millions in work with a hand-rest of years in Germany, Japan and Italy.

► The waste-makers and second-order of our factories are busy in this war, when splitting seconds in production is as important as it is in battle.

Who are the men that provide the arm-rests (right)

the supply-boxes, maintain the seamless belt for wasted half-second and needless human motion?

► They are the "methods" men of industry. They have all sorts of titles: plant managers, operations managers, methods engineers, efficiency engineers, etc. But their job is "to manage men and machines to save time and materials."

In peace, these men were the ones of the industrial system that gave you the world's highest living standard in the world's lowest cost in hours of work.

► In war, these men "methods-menagers," with the intelligent cooperation of American workmen, are making your lives and saving tasks by splitting seconds from the millions of individual operations. This example of time-saving is just an indicator of what a plant operating men does. Such men have many other jobs, including the important job of plant maintenance, but "second-splitting" is the field in which they are the saviors of the whole world.

The American Production Manager is the product of the American industrial system. Complex, long-pointed and useless though war system may seem to the theorist, it merits every challenge, because it is the best system ever devised by man for discovering, developing and rewarding individual initiative.

# SALLY—



## IS UP YOUR ALLEY!

WASHINGTON, and other large city newspapers were used for the advertisement about opposite, because government and public need to understand the men which America has in its trained industrial staffs.

Read what we said about "methods management" in the advertisement, then ask yourself the secret of American gains for production economies in men, materials and time.

One big advantage we have in this country is the interchange of know-how between industries. If an instrument maker reduces a fourth-class hand motion to third-class, all other managers of small part assembly can, and do, find out how it was done.

By means of the articles and advertisements in **FACTORY**, a plant operations magazine, tens of thousands of plant operating men keep abreast of each new development in equipment and technique.

The magazines of the McGraw-Hill Network of Industrial Communication exist solely for swapping ideas. They are backed by the editors and engineer-correspondents, who gather information

wherever it is developed, and funnel it out to the fields where it is needed.

So valuable is this interchange of technical information that many companies are surveying their organizations to make sure that the supply of Industrial Magazines is adequate.

If you would like suggestions as to how to conduct such a survey, just write to Reading Connector Department, McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York.

\* \* \*

### THE MCGRAW-HILL NETWORK

23 publications, which gather "man-eyes" from the "non-production front" through a staff of 153 editors and 725 engineer-correspondents. . . . More than 1,500,000 executives, designers, production men and distributors use the editorial and advertising pages of these magazines to exchange ideas on non-production problems.

### THE MCGRAW-HILL BOOKS

Publications of technical, engineering and business books for colleges, schools, and for business and industrial men.

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### THE MCGRAW-HILL NETWORK OF INDUSTRIAL COMMUNICATION:

\*Factory Management & Maintenance—SPRING 1942 TO AUGUST 1942 AND MAY 1943 TO DATE TIME AND MATERIALS

American Mechanist	Coal Age	Economics	MHI Supplies
Aviation	Construction Methods	Engineering & Mining Journal	Power
Bus Transportation	Electrical Contracting	E. & M. I. Metal and Mineral Markets	Product Engineering
Business Week	Electrical Merchandising	Engineering News-Record	Traffic World
Chemical Metallurgical Engineering	Electrical West	Food Industries	Traction International
	Electrical World		Wholesale's Success

ALSO AFFILIATED WITH BUSINESS PUBLISHERS INTERNATIONAL CORPORATION, PUBLISHERS OF BUSINESS AND TECHNICAL MAGAZINES FOR OVERSEAS CIRCULATION

*Reprints of this advertisement are available on handy letter form.*  
**MCGRAW-HILL PUBLISHING COMPANY, Inc.**

330 WEST 42ND STREET • • NEW YORK

# WAR BOND PAYROLL SAVINGS ROLL OF HONOR

## NEW 10% WAR BOND DRIVES SWELL TREASURY HONOR ROLL

### HOW TO "TOP THAT 10% BY NEW YEAR'S"

Out of the 53 labor-management conferences sponsored by the National Committee for Payroll Savings now conducted by the Treasury Department throughout the Nation has come this formula for reaching the 10% of gross payed War Bond objective:

1. Decide to get 10%.
2. It has been the Treasury experience whenever companies must follow better systems together and demand the job could be done, the job was done.
3. Get a committee of labor and management to work out details for education.
4. They, in turn, will appoint captain-leaders in children who will be responsible for actual collection of no more than 10 weeks.
5. A card should be prepared for each and every worker with his name on it.
6. An estimate should be made of the possible amount each worker can do, made so that no "one will" at 10% is achieved. Some may not be able to do more than 10% of their own pay.
7. Set made to date to meet the above.
8. There should be little or no time between the announcement of the drive and the drive itself.
9. The drive should last not over a week.
10. The opening of the drive may be through a radio, a rally, or a paid announcement in each department.
11. Schedule cooperation between departments, draw personnel check daily.
12. Set in a goal the Treasury goal with a "12."

The most of all  
America's war bond  
payroll savings  
plan. It is the only  
plan that can be  
used by all companies.  
It is the only plan  
that can be used by  
all companies.  
It is the only plan  
that can be used by  
all companies.

As of today, more than 20,000 firms of all sizes have reached the "Honor Roll" goal of at least 10% of the gross payroll in War Bonds. This is a glorious testimony to the voluntary American way of living emergencies.

But there is still more to be done. By January 1st, 1945, the Treasury hopes to have participation from the gross payroll of around 30,000,000 employees averting an average of 8% of earnings to over \$5,000,000 (averaging an average of at least 10% of earnings in War Bonds).

You are urged to set your own sights accordingly and to do all in your power to meet the new year on the Roll of Honor, to give War Bonds for business, and to purchase up to the limit, both personally and as a company, of Series F and G Bonds. (Remember that the new limitation of purchases of F and G Bonds is now one calendar year has been increased from \$50,000 to \$100,000.)

**TYNE IS SHORT.** Our country is counting on you to—

### "TOP THAT 10% BY NEW YEAR'S"



## Save with War Savings Bonds

This space is a Contribution to America's All-Out War Effort by American

AVIATION, December, 1942

## Have You a Special Plate Problem?

**LOMBARD GOVERNOR**  
for precision production work—making accurate and especially heat-treated Angle Plates, Scalloped V Blocks, Lapping Plates, True Surface Plates, Bench Plates, Parallel and Straight Edges. Making these essential inspection parts requires an engineering knowledge which is available to you for your special plate problems.

Send us your drawings and we'll be glad to quote.

**LOMBARD GOVERNOR CORPORATION**  
300 MAIN ST., ASHLAND, MASS., U. S. A.



Niagara Power Squaring Shears are built in a complete range of sizes up to 80 foot cutting lengths. Complete specifications available by writing Niagara Shear & Tool Works, Inc., 100 N. Y. Street Office, General Motors Bldg., Detroit, London Bldg., Cleveland, 59 Church St., New York.

Production of America's largest transport planes and big bombers as well as fighters is being speeded up by batteries of Niagara Power Squaring Shears. Cutting accuracy heretofore unobtainable is made possible by the modern design of Niagara shears. Quick setting pages self measuring to increments of 1/128 inch, flat cutting of narrow strips, drive mechanism enclosed in airtight cases, instant setting screw clutch and full visibility of cutting line are just a few of the many Niagara features.



AVIATION, December, 1942

41

### SOUNDSTONE-NOISE CONTROL



The Soundstone Acoustic Stone shown in the exhaust flue of this engine-propeller unit not only eliminates the noise but does away with all future maintenance. Soundstone is permanent.

Consult Us on Your Sound Problems

## INDUSTRIAL SOUND CONTROL

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V also stands  
for VERSATILITY.

**Arter Rotary Surface Grinders** give you wide versatility—precise surface grinding on a wide variety of surfaces.

Are you using your **Arter Retary Surface Grinders** to their full capacity?

After grinding engineers use all-ways at your service—to help you gain production-plus, the all-important end of the line.

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WORCESTER, MASSACHUSETTS • U. S. A.

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**PURCHASING AGENTS**

WESTERN UNION

AVIATION CO. 115/118 NEW YORK, N. Y.  
AVIATION PARTS MANUFACTURERS MUST  
USE ANTI-CORROSION PAPERS EFFECTIVE  
JANUARY 2ND. C. T. & P. CO.

**O**n July 2nd Army-Navy Accounting Specification paper, gossamer wrapping, was approved by joint action of the War and Navy Departments for use in the procurement of aeronautical supplies and shall become effective not later than January 2nd, 1943.

When this order becomes effective, it will be necessary to wrap all aviation machine parts subject to corrosion or deterioration to protect them from moisture penetration or from leakage of grease and oil, regardless of any methods now used to prevent corrosion.

In anticipation of this specification, Critech has available a full line of expert anti-corrosion papers.

Because these papers are being used today by numerous concerns in the aviation industry and many other aviation manufacturers who have been told to wrap with an aviation paper, we strongly recommend ordering your requirements now.

We will gladly send you Free Samples, if requested on your business letterhead, or if you prefer, our Packaging Engineers are available for consultation without obligation.

CRITERION PAPER & TWINE CO.

NEW YORK, N. Y.

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airplane design  
and drafting*

...follow this guide-  
book of effective pro-  
cedures and working  
plans and captions.



This book gives engineers designers and others a concise but complete view of the supplies in a design problem. For those not as familiar with the subject, any phase of design work and its relation to the complete design. Features of the supplies and its parts are covered from the standpoint of showing functions of the various elements used and materials, factors affecting design, and the procedure of the design department or group. Fully covers the background information to the designer, from scientific weights and stress problems, through the work of an engineer's assistant, and through general

*Just Published*

# Introduction to AIRCRAFT DESIGN

By THOMAS F. FALCONER

Director of Education, Connecticut General Assembly

274 pages, 6 x 9, 24 illustrations, \$125

Qualifying detailed products, questions, and answers leads to getting engineering help. This week you should be in those expert rooms and problems, those detailed, questions and answers need to get a much greater exposure and exposure designed.

Gives practical material on rock ropes and

—energia termică și electrică produsă în aer condiționat

- determining optimum conditions for staining press sheets of 10 square centimeters and 2000
- conditions for the final square meter
- number of sheets for each condition

—length of wing  
—length of wing  
—length of wing

## CONTENTS

- [illegible]

10. MAKE THE RETURN — SEND THE COUPON TODAY!

NAME: JOHN J. HARRIS      DOB: 01/15/1945      SEX: M

ADDRESS: 1000 10th Ave. 10th Fl. New York, NY 10018

CITY: NEW YORK      STATE: NY      ZIP: 10018

PHONE: (212) 850-1234

DATE: 01/15/1995      TIME: 10:00 AM



Confidence—supreme confidence in his arms and equipment—is the trait which makes the American fighter what he is every battle. He knows, for example, that when he wants to give warning of sudden danger, he expects an enemy gun, so trained in rapid movements, his own lightness was a find in the moment of extreme need.

Many of the microphones used by our Armed Forces are made by Kallings. They meet the signal sensitivity, transmission and performance specifications of the U. S. Government. But the entire Kallings plant, with its great production facilities, has capacity to handle orders orders for still more microphones. If the construction equipment you supply for the Armed Forces calls for microphones—hand, palm or throat types—go in touch at once with the Kallings Industrial Sales Department.

#### On Contract for Suppliers to the Armed Forces

During the 1980s, the growth and development of commerce in Singapore resulted in substantial increases in the number of shops and sales in physical markets, leading to a high level of competition. As a result, many shops and stalls in Singapore, the United Kingdom and elsewhere have been forced to close down. In Singapore, the number of shops and stalls in the market has declined by more than 50% in the last 10 years. The number of shops and stalls in the market has declined by more than 50% in the last 10 years. The number of shops and stalls in the market has declined by more than 50% in the last 10 years.

**KELLOGG SWITCHBOARD & SUPPLY CO.**  
6470 E. Glisan Ave., Chicago, Ill.

### Counting and Counting Devices

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**ALSO AVAILABLE**  
**HERE**

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Equipment* 170 WAS AVE. PHOENIX

State exactly what your supplies of springs and screw machine parts **MUST** be if you are to meet your production requirements. If you have a spring problem lay in 1½" wire steel with compression, combination, conical, irregular and instruments . . . or screw machine parts requirements up to 1½" (solid, drilled, slotted, tapped or threaded) . . . and on your blue prints Examine portions when necessary.

**PECK SPRINGS**  
AND SCREW MACHINE PARTS



BLIND FLYING MOORS	ANYTHING OF FABRIC
ENGINE COVERS	CORROD BULLS
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HAND COVERS	CONV ASSEMBLIES
CUSHIONS	WIND COVERS
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# Unfailing PERFORMANCE

In step with the swift progress of aviation, the modern parachute has come into its own as a vital implement of war. It saves the lives of aviators in distress, breaks load and cushions to bungee drops, and drops Paratroopers behind enemy lines. Such assignments call for unfailing performance—absolute perfection in every detail and every step of construction. With never-ending scientific research, technical developments testing and inspection throughout every phase of production, Pioneer Parachutes have stood these rigid tests, and today stand in the forefront of the industry.



## PIONEER PARACHUTE COMPANY, INC.

MANCHESTER, CONNECTICUT, U. S. A.

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TELEPHONE: Providence 6311

**where you want them  
when you want them**



The *portability* and *flexibility* of Delta machines open many roads to increased production. Here illustrated are two standard Delta Drill Presses set up alongside a screw-grinder. (On-scene pictures also handled operations on drill presses while waiting for power feed on screw machine.)

**Other examples:** When free drilling and turning operations are required, a single standard Delta Drill Press is moved up alongside a floor speeder drill press... or used simultaneously with and using same, individual Delta Drill Presses, Gun-drills and Hand Tools are set up alongside each another's bench. (Full details will be furnished on request. Illustrating these and many other cases where Delta portability and flexibility have been secured to solve production problems.)

**DELTA DESIGN  
ALWAYS OFFERS THESE  
ADVANTAGES:**

Low First Cost  
Low Maintenance Cost  
Seasonal Operation  
Reduced Labor Cost  
Greater Flexibility  
Portability



### Send for FREE "FOOLING TIPS"

Write for the personal tips hidden during long, busy maintenance or setup, advantages of the entire history of DELTA Milwaukee machinery. Also for latest complete catalog. Get in touch with your Delta Industrial Distributor or write us at The Delta Manufacturing Company, 2200 E. Touhy Ave., Milwaukee, Wis.



The designing engineers of aircraft companies believe "an ounce of prevention is worth a pound of cure." When they need material that will withstand tremendous stresses, many specify and use a strong rugged bronze that they know is the best available for the service—Ampco Metal, which has proved its worth in hundreds of severe industrial applications.

In aircraft application, the use of Ampco Metal safeguards the operation of important equipment in combat planes. Thousands of dollars worth of bombers and fighters and the lives of skilled pilots are safeguarded through use of Ampco parts. Wherever bronzes are needed, play safe with Ampco!

Literature on request.

### AMPCO METAL, INC.

DEPARTMENT A-12 MILWAUKEE, WISCONSIN



## *If this were your* **Roosevelt Aviation School**

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Master Airplane and  
Engine Mechanic Course  
you would hold in your hand the  
key to a Career in Aviation. You  
would be properly trained to meet  
every requirement for Civilian  
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planes in the air. No other type  
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you to work and keep you at  
work—now and after the war—  
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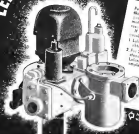
*1543 Classis Street, Monday,  
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now for your tuition when you receive  
MASTER AIRPLANE AND ENGINE MECHANIC COURSE  
Material.)  
I have added \_\_\_\_\_ \$\_\_\_\_\_  
Total \$\_\_\_\_\_

**LELAND MOTORS POWER THE ARMY'S GAS PUMPS**



Now all you will have to do is select your favorite...  
 1. **Free**...  
 2. **100%**...  
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New! 1/2 hp. stainless pump, powered with in-lashed Motor, in Army Service.



Typical plants like the now German-owned *Arundo donax* should be equipped with growth that can take it. That can include rapid-fire, since it is evidence of America's fast-growing strategy of the day.

Superior equipment is one outstanding feature in the inventory of Vauxhall cars. A major reason for this is that Vauxhall is a leading manufacturer of car equipment by the 100, 1000, 100,000 and 1,000,000.

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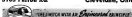
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